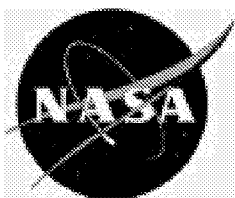


NASA/SP—1999-7037/SUPPL408
October 1999

AERONAUTICAL ENGINEERING

A CONTINUING BIBLIOGRAPHY WITH INDEXES



National Aeronautics and
Space Administration
Langley Research Center
**Scientific and Technical
Information Program Office**

The NASA STI Program Office . . . in Profile

Since its founding, NASA has been dedicated to the advancement of aeronautics and space science. The NASA Scientific and Technical Information (STI) Program Office plays a key part in helping NASA maintain this important role.

The NASA STI Program Office is operated by Langley Research Center, the lead center for NASA's scientific and technical information. The NASA STI Program Office provides access to the NASA STI Database, the largest collection of aeronautical and space science STI in the world. The Program Office is also NASA's institutional mechanism for disseminating the results of its research and development activities. These results are published by NASA in the NASA STI Report Series, which includes the following report types:

- **TECHNICAL PUBLICATION.** Reports of completed research or a major significant phase of research that present the results of NASA programs and include extensive data or theoretical analysis. Includes compilations of significant scientific and technical data and information deemed to be of continuing reference value. NASA's counterpart of peer-reviewed formal professional papers but has less stringent limitations on manuscript length and extent of graphic presentations.
- **TECHNICAL MEMORANDUM.** Scientific and technical findings that are preliminary or of specialized interest, e.g., quick release reports, working papers, and bibliographies that contain minimal annotation. Does not contain extensive analysis.
- **CONTRACTOR REPORT.** Scientific and technical findings by NASA-sponsored contractors and grantees.

- **CONFERENCE PUBLICATION.** Collected papers from scientific and technical conferences, symposia, seminars, or other meetings sponsored or cosponsored by NASA.
- **SPECIAL PUBLICATION.** Scientific, technical, or historical information from NASA programs, projects, and missions, often concerned with subjects having substantial public interest.
- **TECHNICAL TRANSLATION.** English-language translations of foreign scientific and technical material pertinent to NASA's mission.

Specialized services that complement the STI Program Office's diverse offerings include creating custom thesauri, building customized databases, organizing and publishing research results . . . even providing videos.

For more information about the NASA STI Program Office, see the following:

- Access the NASA STI Program Home Page at [*http://www.sti.nasa.gov*](http://www.sti.nasa.gov)
- E-mail your question via the Internet to [*help@sti.nasa.gov*](mailto:help@sti.nasa.gov)
- Fax your question to the NASA STI Help Desk at (301) 621-0134
- Telephone the NASA STI Help Desk at (301) 621-0390
- Write to:
NASA STI Help Desk
NASA Center for AeroSpace Information
7121 Standard Drive
Hanover, MD 21076-1320

Introduction

This supplemental issue of *Aeronautical Engineering, A Continuing Bibliography with Indexes* (NASA/SP—1999-7037) lists reports, articles, and other documents recently announced in the NASA STI Database.

The coverage includes documents on the engineering and theoretical aspects of design, construction, evaluation, testing, operation, and performance of aircraft (including aircraft engines) and associated components, equipment, and systems. It also includes research and development in aerodynamics, aeronautics, and ground support equipment for aeronautical vehicles.

Each entry in the publication consists of a standard bibliographic citation accompanied, in most cases, by an abstract.

The NASA CASI price code table, addresses of organizations, and document availability information are included before the abstract section.

Two indexes—subject and author are included after the abstract section.

SCAN Goes Electronic!

If you have electronic mail or if you can access the Internet, you can view biweekly issues of *SCAN* from your desktop absolutely free!

Electronic SCAN takes advantage of computer technology to inform you of the latest worldwide, aerospace-related, scientific and technical information that has been published.

No more waiting while the paper copy is printed and mailed to you. You can view *Electronic SCAN* the same day it is released—up to 191 topics to browse at your leisure. When you locate a publication of interest, you can print the announcement. You can also go back to the *Electronic SCAN* home page and follow the ordering instructions to quickly receive the full document.

Start your access to *Electronic SCAN* today. Over 1,000 announcements of new reports, books, conference proceedings, journal articles...and more—available to your computer every two weeks.

**Timely
Flexible
Complete
FREE!**

For Internet access to *E-SCAN*, use any of the following addresses:

<http://www.sti.nasa.gov>

[ftp.sti.nasa.gov](ftp://sti.nasa.gov)

[gopher.sti.nasa.gov](gopher://sti.nasa.gov)

To receive a free subscription, send e-mail for complete information about the service first. Enter **scan@sti.nasa.gov** on the address line. Leave the subject and message areas blank and send. You will receive a reply in minutes.

Then simply determine the *SCAN* topics you wish to receive and send a second e-mail to **listserv@sti.nasa.gov**. Leave the subject line blank and enter a subscribe command, denoting which topic you want and your name in the message area, formatted as follows:

Subscribe SCAN-02-01 Jane Doe

For additional information, e-mail a message to **help@sti.nasa.gov**.

Phone: (301) 621-0390

Fax: (301) 621-0134

Write: NASA STI Help Desk
NASA Center for AeroSpace Information
7121 Standard Drive
Hanover, MD 21076-1320

Looking just for *Aerospace Medicine and Biology* reports?

Although hard copy distribution has been discontinued, you can still receive these vital announcements through your *E-SCAN* subscription. Just **Subscribe SCAN-AEROMED Jane Doe** in the message area of your e-mail to **listserv@sti.nasa.gov**.



Table of Contents

Records are arranged in categories 1 through 19, the first nine coming from the Aeronautics division of *STAR*, followed by the remaining division titles. Selecting a category will link you to the collection of records cited in this issue pertaining to that category.

01	Aeronautics (General)	1
	Includes general research topics related to manned and unmanned aircraft and the problems of flight within the Earth's atmosphere. Also includes manufacturing, maintenance, and repair of aircraft.	
02	Aerodynamics	2
	Includes aerodynamics of flight vehicles, test bodies, airframe components and combinations, wings, and control surfaces. Also includes aerodynamics of rotors, stators, fans and other elements of turbomachinery.	
03	Air Transportation and Safety	6
	Includes passenger and cargo air transport operations; aircraft ground operations; flight safety and hazards; and aircraft accidents.	
04	Aircraft Communications and Navigation	15
	Includes all modes of communication with and between aircraft; air navigation systems (satellite and ground based); and air traffic control.	
05	Aircraft Design, Testing and Performance	17
	Includes all stages of design of aircraft and aircraft structures and systems. Also includes aircraft testing, performance, and evaluation, and aircraft and flight simulation technology.	
06	Avionics and Aircraft Instrumentation	27
	Includes all avionics systems, cockpit and cabin display devices; and flight instruments intended for use in aircraft.	
07	Aircraft Propulsion and Power	28
	Includes prime propulsion systems and systems components, e.g., gas turbine engines and compressors; and onboard auxiliary power plants for aircraft.	
08	Aircraft Stability and Control	38
	Includes flight dynamics, aircraft handling qualities; piloting; flight controls; and autopilots.	
09	Research and Support Facilities (Air)	41
	Includes airports, runways, hangars, and aircraft repair and overhaul facilities; wind tunnels, water tunnels, and shock tubes; flight simulators; and aircraft engine test stands. Also includes airport ground equipment and systems.	

10	Astronautics	43
	Includes astronautics (general); astrodynamics; ground support systems and facilities (space); launch vehicles and space vehicles; space transportation; space communications, spacecraft communications, command and tracking; spacecraft design, testing and performance; spacecraft instrumentation and astronics; and spacecraft propulsion and power.	
11	Chemistry and Materials	48
	Includes chemistry and materials (general); composite materials; inorganic, organic, and physical chemistry; metals and metallic materials; nonmetallic materials; propellants and fuels; and space processing.	
12	Engineering	49
	Includes engineering (general); communications and radar; electronics and electrical engineering; fluid mechanics and thermodynamics; instrumentation and photography; lasers and masers; mechanical engineering; quality assurance and reliability; and structural mechanics.	
13	Geosciences	55
	Includes geosciences (general); earth resources and remote sensing; energy production and conversion; environment pollution; geophysics; meteorology and climatology; and oceanography.	
14	Life Sciences	56
	Includes life sciences (general); aerospace medicine; behavioral sciences; man/system technology and life support; and exobiology.	
15	Mathematical and Computer Sciences	57
	Includes mathematical and computer sciences (general); computer operations and hardware; computer programming and software; computer systems; cybernetics, artificial intelligence and robotics; numerical analysis; statistics and probability; systems analysis and operations research; and theoretical mathematics.	
16	Physics	58
	Includes physics (general); acoustics; atomic and molecular physics; nuclear physics; optics; plasma physics; solid-state physics; and physics of elementary particles and fields.	
17	Social Sciences	N.A.
	Includes social sciences (general); administration and management; documentation and information science; economics and cost analysis; law, political science and space policy; and technology utilization and surface transportation.	
18	Space Sciences	N.A.
	Includes space sciences (general); astronomy; astrophysics; lunar and planetary science and exploration; solar physics; and space radiation.	
19	General	N.A.

Indexes

Two indexes are available. You may use the find command under the tools menu while viewing the PDF file for direct match searching on any text string. You may also view the indexes provided, for searching on *NASA Thesaurus* subject terms and author names.

Subject Term Index

ST-1

Author Index

PA-1

Selecting an index above will link you to that comprehensive listing.

Document Availability

Select **Availability Info** for important information about NASA Scientific and Technical Information (STI) Program Office products and services, including registration with the NASA Center for AeroSpace Information (CASI) for access to the NASA CASI TRS (Technical Report Server), and availability and pricing information for cited documents.

The New NASA Video Catalog is Here

To order your **Free!** copy,
call the NASA STI Help Desk at
(301) 621-0390,

fax to

(301) 621-0134,

e-mail to

help@sti.nasa.gov,

or visit the NASA STI Program

homepage at

<http://www.sti.nasa.gov>

(Select STI Program Bibliographic Announcements)

Explore the Universe!

Document Availability Information

The mission of the NASA Scientific and Technical (STI) Program Office is to quickly, efficiently, and cost-effectively provide the NASA community with desktop access to STI produced by NASA and the world's aerospace industry and academia. In addition, we will provide the aerospace industry, academia, and the taxpayer access to the intellectual scientific and technical output and achievements of NASA.

Eligibility and Registration for NASA STI Products and Services

The NASA STI Program offers a wide variety of products and services to achieve its mission. Your affiliation with NASA determines the level and type of services provided by the NASA STI Program. To assure that appropriate level of services are provided, NASA STI users are requested to register at the NASA Center for AeroSpace Information (CASI). Please contact NASA CASI in one of the following ways:

E-mail: help@sti.nasa.gov
Fax: 301-621-0134
Phone: 301-621-0390
Mail: ATTN: Registration Services
NASA Center for AeroSpace Information
7121 Standard Drive
Hanover, MD 21076-1320

Limited Reproducibility

In the database citations, a note of limited reproducibility appears if there are factors affecting the reproducibility of more than 20 percent of the document. These factors include faint or broken type, color photographs, black and white photographs, foldouts, dot matrix print, or some other factor that limits the reproducibility of the document. This notation also appears on the microfiche header.

NASA Patents and Patent Applications

Patents and patent applications owned by NASA are announced in the STI Database. Printed copies of patents (which are not microfiched) are available for purchase from the U.S. Patent and Trademark Office.

When ordering patents, the U.S. Patent Number should be used, and payment must be remitted in advance, by money order or check payable to the Commissioner of Patents and Trademarks. Prepaid purchase coupons for ordering are also available from the U.S. Patent and Trademark Office.

NASA patent application specifications are sold in both paper copy and microfiche by the NASA Center for AeroSpace Information (CASI). The document ID number should be used in ordering either paper copy or microfiche from CASI.

The patents and patent applications announced in the STI Database are owned by NASA and are available for royalty-free licensing. Requests for licensing terms and further information should be addressed to:

National Aeronautics and Space Administration
Associate General Counsel for Intellectual Property
Code GP
Washington, DC 20546-0001

Sources for Documents

One or more sources from which a document announced in the STI Database is available to the public is ordinarily given on the last line of the citation. The most commonly indicated sources and their acronyms or abbreviations are listed below, with an Addresses of Organizations list near the back of this section. If the publication is available from a source other than those listed, the publisher and his address will be displayed on the availability line or in combination with the corporate source.

Avail: NASA CASI. Sold by the NASA Center for AeroSpace Information. Prices for hard copy (HC) and microfiche (MF) are indicated by a price code following the letters HC or MF in the citation. Current values are given in the NASA CASI Price Code Table near the end of this section.

Note on Ordering Documents: When ordering publications from NASA CASI, use the document ID number or other report number. It is also advisable to cite the title and other bibliographic identification.

Avail: SOD (or GPO). Sold by the Superintendent of Documents, U.S. Government Printing Office, in hard copy.

Avail: BLL (formerly NLL): British Library Lending Division, Boston Spa, Wetherby, Yorkshire, England. Photocopies available from this organization at the price shown. (If none is given, inquiry should be addressed to the BLL.)

Avail: DOE Depository Libraries. Organizations in U.S. cities and abroad that maintain collections of Department of Energy reports, usually in microfiche form, are listed in Energy Research Abstracts. Services available from the DOE and its depositories are described in a booklet, *DOE Technical Information Center—Its Functions and Services* (TID-4660), which may be obtained without charge from the DOE Technical Information Center.

Avail: ESDU. Pricing information on specific data, computer programs, and details on ESDU International topic categories can be obtained from ESDU International.

Avail: Fachinformationszentrum Karlsruhe. Gesellschaft für wissenschaftlich-technische Information mbH 76344 Eggenstein-Leopoldshafen, Germany.

- Avail: HMSO. Publications of Her Majesty's Stationery Office are sold in the U.S. by Pendragon House, Inc. (PHI), Redwood City, CA. The U.S. price (including a service and mailing charge) is given, or a conversion table may be obtained from PHI.
- Avail: Issuing Activity, or Corporate Author, or no indication of availability. Inquiries as to the availability of these documents should be addressed to the organization shown in the citation as the corporate author of the document.
- Avail: NASA Public Document Rooms. Documents so indicated may be examined at or purchased from the National Aeronautics and Space Administration (JBD-4), Public Documents Room (Room 1H23), Washington, DC 20546-0001, or public document rooms located at NASA installations, and the NASA Pasadena Office at the Jet Propulsion Laboratory.
- Avail: NTIS. Sold by the National Technical Information Service. Initially distributed microfiche under the NTIS SRIM (Selected Research in Microfiche) are available. For information concerning this service, consult the NTIS Subscription Section, Springfield, VA 22161.
- Avail: Univ. Microfilms. Documents so indicated are dissertations selected from Dissertation Abstracts and are sold by University Microfilms as xerographic copy (HC) and microfilm. All requests should cite the author and the Order Number as they appear in the citation.
- Avail: US Patent and Trademark Office. Sold by Commissioner of Patents and Trademarks, U.S. Patent and Trademark Office, at the standard price of \$1.50 each, postage free.
- Avail: (US Sales Only). These foreign documents are available to users within the United States from the National Technical Information Service (NTIS). They are available to users outside the United States through the International Nuclear Information Service (INIS) representative in their country, or by applying directly to the issuing organization.
- Avail: USGS. Originals of many reports from the U.S. Geological Survey, which may contain color illustrations, or otherwise may not have the quality of illustrations preserved in the microfiche or facsimile reproduction, may be examined by the public at the libraries of the USGS field offices whose addresses are listed on the Addresses of Organizations page. The libraries may be queried concerning the availability of specific documents and the possible utilization of local copying services, such as color reproduction.

Addresses of Organizations

British Library Lending Division
Boston Spa, Wetherby, Yorkshire
England

Commissioner of Patents and Trademarks
U.S. Patent and Trademark Office
Washington, DC 20231

Department of Energy
Technical Information Center
P.O. Box 62
Oak Ridge, TN 37830

European Space Agency–
Information Retrieval Service ESRIN
Via Galileo Galilei
00044 Frascati (Rome) Italy

ESDU International
27 Corsham Street
London
N1 6UA
England

Fachinformationszentrum Karlsruhe
Gesellschaft für wissenschaftlich–technische
Information mbH
76344 Eggenstein–Leopoldshafen, Germany

Her Majesty's Stationery Office
P.O. Box 569, S.E. 1
London, England

NASA Center for AeroSpace Information
7121 Standard Drive
Hanover, MD 21076-1320

(NASA STI Lead Center)
National Aeronautics and Space Administration
Scientific and Technical Information Program Office
Langley Research Center – MS157
Hampton, VA 23681

National Technical Information Service
5285 Port Royal Road
Springfield, VA 22161

Pendragon House, Inc.
899 Broadway Avenue
Redwood City, CA 94063

Superintendent of Documents
U.S. Government Printing Office
Washington, DC 20402

University Microfilms
A Xerox Company
300 North Zeeb Road
Ann Arbor, MI 48106

University Microfilms, Ltd.
Tylers Green
London, England

U.S. Geological Survey Library National Center
MS 950
12201 Sunrise Valley Drive
Reston, VA 22092

U.S. Geological Survey Library
2255 North Gemini Drive
Flagstaff, AZ 86001

U.S. Geological Survey
345 Middlefield Road
Menlo Park, CA 94025

U.S. Geological Survey Library
Box 25046
Denver Federal Center, MS914
Denver, CO 80225

NASA CASI Price Code Table

(Effective July 1, 1998)

Code	U.S., Canada, & Mexico		Foreign	Code	U.S., Canada, & Mexico		Foreign
A01	\$ 8.00		\$ 16.00	E01	\$101.00		\$202.00
A02	12.00		24.00	E02	109.50		219.00
A03	23.00		46.00	E03	119.50		238.00
A04	25.50		51.00	E04	128.50		257.00
A05	27.00		54.00	E05	138.00		276.00
A06	29.50		59.00	E06	146.50		293.00
A07	33.00		66.00	E07	156.00		312.00
A08	36.00		72.00	E08	165.50		331.00
A09	41.00		82.00	E09	174.00		348.00
A10	44.00		88.00	E10	183.50		367.00
A11	47.00		94.00	E11	193.00		386.00
A12	51.00		102.00	E12	201.00		402.00
A13	54.00		108.00	E13	210.50		421.00
A14	56.00		112.00	E14	220.00		440.00
A15	58.00		116.00	E15	229.50		459.00
A16	60.00		120.00	E16	238.00		476.00
A17	62.00		124.00	E17	247.50		495.00
A18	65.50		131.00	E18	257.00		514.00
A19	67.50		135.00	E19	265.50		531.00
A20	69.50		139.00	E20	275.00		550.00
A21	71.50		143.00	E21	284.50		569.00
A22	77.00		154.00	E22	293.00		586.00
A23	79.00		158.00	E23	302.50		605.00
A24	81.00		162.00	E24	312.00		624.00
A25	83.00		166.00	E99	Contact NASA CASI		
A99	Contact NASA CASI						

Payment Options

All orders must be prepaid unless you are registered for invoicing or have a deposit account with the NASA CASI. Payment can be made by VISA, MasterCard, American Express, or Diner's Club credit card. Checks or money orders must be in U.S. currency and made payable to "NASA Center for AeroSpace Information." To register, please request a registration form through the NASA STI Help Desk at the numbers or addresses below.

Handling fee per item is \$1.50 domestic delivery to any location in the United States and \$9.00 foreign delivery to Canada, Mexico, and other foreign locations. Video orders incur an additional \$2.00 handling fee per title.

The fee for shipping the safest and fastest way via Federal Express is in addition to the regular handling fee explained above—\$5.00 domestic per item, \$27.00 foreign for the first 1-3 items, \$9.00 for each additional item.

Return Policy

The NASA Center for AeroSpace Information will replace or make full refund on items you have requested if we have made an error in your order, if the item is defective, or if it was received in damaged condition, and you contact CASI within 30 days of your original request.

NASA Center for AeroSpace Information
7121 Standard Drive
Hanover, MD 21076-1320

E-mail: help@sti.nasa.gov
Fax: (301) 621-0134
Phone: (301) 621-0390

Federal Depository Library Program

In order to provide the general public with greater access to U.S. Government publications, Congress established the Federal Depository Library Program under the Government Printing Office (GPO), with 53 regional depositories responsible for permanent retention of material, inter-library loan, and reference services. At least one copy of nearly every NASA and NASA-sponsored publication, either in printed or microfiche format, is received and retained by the 53 regional depositories. A list of the Federal Regional Depository Libraries, arranged alphabetically by state, appears at the very end of this section. These libraries are not sales outlets. A local library can contact a regional depository to help locate specific reports, or direct contact may be made by an individual.

Public Collection of NASA Documents

An extensive collection of NASA and NASA-sponsored publications is maintained by the British Library Lending Division, Boston Spa, Wetherby, Yorkshire, England for public access. The British Library Lending Division also has available many of the non-NASA publications cited in the STI Database. European requesters may purchase facsimile copy or microfiche of NASA and NASA-sponsored documents FIZ–Fachinformation Karlsruhe–Bibliographic Service, D-76344 Eggenstein-Leopoldshafen, Germany and TIB–Technische Informationsbibliothek, P.O. Box 60 80, D-30080 Hannover, Germany.

Submitting Documents

All users of this abstract service are urged to forward reports to be considered for announcement in the STI Database. This will aid NASA in its efforts to provide the fullest possible coverage of all scientific and technical publications that might support aeronautics and space research and development. If you have prepared relevant reports (other than those you will transmit to NASA, DOD, or DOE through the usual contract- or grant-reporting channels), please send them for consideration to:

ATTN: Acquisitions Specialist
NASA Center for AeroSpace Information
7121 Standard Drive
Hanover, MD 21076-1320.

Reprints of journal articles, book chapters, and conference papers are also welcome.

You may specify a particular source to be included in a report announcement if you wish; otherwise the report will be placed on a public sale at the NASA Center for AeroSpace Information. Copyrighted publications will be announced but not distributed or sold.

Federal Regional Depository Libraries

ALABAMA

AUBURN UNIV. AT MONTGOMERY LIBRARY

Documents Dept.
7300 University Dr.
Montgomery, AL 36117-3596
(205) 244-3650 Fax: (205) 244-0678

UNIV. OF ALABAMA

Amelia Gayle Gorgas Library
Govt. Documents
P.O. Box 870266
Tuscaloosa, AL 35487-0266
(205) 348-6046 Fax: (205) 348-0760

ARIZONA

DEPT. OF LIBRARY, ARCHIVES, AND PUBLIC RECORDS

Research Division
Third Floor, State Capitol
1700 West Washington
Phoenix, AZ 85007
(602) 542-3701 Fax: (602) 542-4400

ARKANSAS

ARKANSAS STATE LIBRARY

State Library Service Section
Documents Service Section
One Capitol Mall
Little Rock, AR 72201-1014
(501) 682-2053 Fax: (501) 682-1529

CALIFORNIA

CALIFORNIA STATE LIBRARY

Govt. Publications Section
P.O. Box 942837 - 914 Capitol Mall
Sacramento, CA 94337-0091
(916) 654-0069 Fax: (916) 654-0241

COLORADO

UNIV. OF COLORADO - BOULDER

Libraries - Govt. Publications
Campus Box 184
Boulder, CO 80309-0184
(303) 492-8834 Fax: (303) 492-1881

DENVER PUBLIC LIBRARY

Govt. Publications Dept. BSG
1357 Broadway
Denver, CO 80203-2165
(303) 640-8846 Fax: (303) 640-8817

CONNECTICUT

CONNECTICUT STATE LIBRARY

231 Capitol Avenue
Hartford, CT 06106
(203) 566-4971 Fax: (203) 566-3322

FLORIDA

UNIV. OF FLORIDA LIBRARIES

Documents Dept.
240 Library West
Gainesville, FL 32611-2048
(904) 392-0366 Fax: (904) 392-7251

GEORGIA

UNIV. OF GEORGIA LIBRARIES

Govt. Documents Dept.
Jackson Street
Athens, GA 30602-1645
(706) 542-8949 Fax: (706) 542-4144

HAWAII

UNIV. OF HAWAII

Hamilton Library
Govt. Documents Collection
2550 The Mall
Honolulu, HI 96822
(808) 948-8230 Fax: (808) 956-5968

IDAHO

UNIV. OF IDAHO LIBRARY

Documents Section
Rayburn Street
Moscow, ID 83844-2353
(208) 885-6344 Fax: (208) 885-6817

ILLINOIS

ILLINOIS STATE LIBRARY

Federal Documents Dept.
300 South Second Street
Springfield, IL 62701-1796
(217) 782-7596 Fax: (217) 782-6437

INDIANA

INDIANA STATE LIBRARY

Serials/Documents Section
140 North Senate Avenue
Indianapolis, IN 46204-2296
(317) 232-3679 Fax: (317) 232-3728

IOWA

UNIV. OF IOWA LIBRARIES

Govt. Publications
Washington & Madison Streets
Iowa City, IA 52242-1166
(319) 335-5926 Fax: (319) 335-5900

KANSAS

UNIV. OF KANSAS

Govt. Documents & Maps Library
6001 Malott Hall
Lawrence, KS 66045-2800
(913) 864-4660 Fax: (913) 864-3855

KENTUCKY

UNIV. OF KENTUCKY

King Library South
Govt. Publications/Maps Dept.
Patterson Drive
Lexington, KY 40506-0039
(606) 257-3139 Fax: (606) 257-3139

LOUISIANA

LOUISIANA STATE UNIV.

Middleton Library
Govt. Documents Dept.
Baton Rouge, LA 70803-3312
(504) 388-2570 Fax: (504) 388-6992

LOUISIANA TECHNICAL UNIV.

Prescott Memorial Library
Govt. Documents Dept.
Ruston, LA 71272-0046
(318) 257-4962 Fax: (318) 257-2447

MAINE

UNIV. OF MAINE

Raymond H. Fogler Library
Govt. Documents Dept.
Orono, ME 04469-5729
(207) 581-1673 Fax: (207) 581-1653

MARYLAND

UNIV. OF MARYLAND - COLLEGE PARK

McKeldin Library
Govt. Documents/Maps Unit
College Park, MD 20742
(301) 405-9165 Fax: (301) 314-9416

MASSACHUSETTS

BOSTON PUBLIC LIBRARY

Govt. Documents
666 Boylston Street
Boston, MA 02117-0286
(617) 536-5400, ext. 226
Fax: (617) 536-7758

MICHIGAN

DETROIT PUBLIC LIBRARY

5201 Woodward Avenue
Detroit, MI 48202-4093
(313) 833-1025 Fax: (313) 833-0156

LIBRARY OF MICHIGAN

Govt. Documents Unit
P.O. Box 30007
717 West Allegan Street
Lansing, MI 48909
(517) 373-1300 Fax: (517) 373-3381

MINNESOTA

UNIV. OF MINNESOTA

Govt. Publications
409 Wilson Library
309 19th Avenue South
Minneapolis, MN 55455
(612) 624-5073 Fax: (612) 626-9353

MISSISSIPPI

UNIV. OF MISSISSIPPI

J.D. Williams Library
106 Old Gym Bldg.
University, MS 38677
(601) 232-5857 Fax: (601) 232-7465

MISSOURI

UNIV. OF MISSOURI - COLUMBIA

106B Ellis Library
Govt. Documents Sect.
Columbia, MO 65201-5149
(314) 882-6733 Fax: (314) 882-8044

MONTANA

UNIV. OF MONTANA

Mansfield Library
Documents Division
Missoula, MT 59812-1195
(406) 243-6700 Fax: (406) 243-2060

NEBRASKA

UNIV. OF NEBRASKA - LINCOLN

D.L. Love Memorial Library
Lincoln, NE 68588-0410
(402) 472-2562 Fax: (402) 472-5131

NEVADA

THE UNIV. OF NEVADA LIBRARIES

Business and Govt. Information Center
Reno, NV 89557-0044
(702) 784-8579 Fax: (702) 784-1751

NEW JERSEY

NEWARK PUBLIC LIBRARY

Science Div. - Public Access
P.O. Box 630
Five Washington Street
Newark, NJ 07101-7812
(201) 733-7782 Fax: (201) 733-5648

NEW MEXICO

UNIV. OF NEW MEXICO

General Library
Govt. Information Dept.
Albuquerque, NM 87131-1466
(505) 277-5441 Fax: (505) 277-6019

NEW MEXICO STATE LIBRARY

325 Don Gaspar Avenue
Santa Fe, NM 87503
(505) 827-3824 Fax: (505) 827-3888

NEW YORK

NEW YORK STATE LIBRARY

Cultural Education Center
Documents/Gift & Exchange Section
Empire State Plaza
Albany, NY 12230-0001
(518) 474-5355 Fax: (518) 474-5786

NORTH CAROLINA

UNIV. OF NORTH CAROLINA - CHAPEL HILL

Walter Royal Davis Library
CB 3912, Reference Dept.
Chapel Hill, NC 27514-8890
(919) 962-1151 Fax: (919) 962-4451

NORTH DAKOTA

NORTH DAKOTA STATE UNIV. LIB.

Documents
P.O. Box 5599
Fargo, ND 58105-5599
(701) 237-8886 Fax: (701) 237-7138

UNIV. OF NORTH DAKOTA

Chester Fritz Library
University Station
P.O. Box 9000 - Centennial and University Avenue
Grand Forks, ND 58202-9000
(701) 777-4632 Fax: (701) 777-3319

OHIO

STATE LIBRARY OF OHIO

Documents Dept.
65 South Front Street
Columbus, OH 43215-4163
(614) 644-7051 Fax: (614) 752-9178

OKLAHOMA

OKLAHOMA DEPT. OF LIBRARIES

U.S. Govt. Information Division
200 Northeast 18th Street
Oklahoma City, OK 73105-3298
(405) 521-2502, ext. 253
Fax: (405) 525-7804

OKLAHOMA STATE UNIV.

Edmon Low Library
Stillwater, OK 74078-0375
(405) 744-6546 Fax: (405) 744-5183

OREGON

PORTLAND STATE UNIV.

Branford P. Millar Library
934 Southwest Harrison
Portland, OR 97207-1151
(503) 725-4123 Fax: (503) 725-4524

PENNSYLVANIA

STATE LIBRARY OF PENN.

Govt. Publications Section
116 Walnut & Commonwealth Ave.
Harrisburg, PA 17105-1601
(717) 787-3752 Fax: (717) 783-2070

SOUTH CAROLINA

CLEMSON UNIV.

Robert Muldrow Cooper Library
Public Documents Unit
P.O. Box 343001
Clemson, SC 29634-3001
(803) 656-5174 Fax: (803) 656-3025

UNIV. OF SOUTH CAROLINA

Thomas Cooper Library
Green and Sumter Streets
Columbia, SC 29208
(803) 777-4841 Fax: (803) 777-9503

TENNESSEE

UNIV. OF MEMPHIS LIBRARIES

Govt. Publications Dept.
Memphis, TN 38152-0001
(901) 678-2206 Fax: (901) 678-2511

TEXAS

TEXAS STATE LIBRARY

United States Documents
P.O. Box 12927 - 1201 Brazos
Austin, TX 78701-0001
(512) 463-5455 Fax: (512) 463-5436

TEXAS TECH. UNIV. LIBRARIES

Documents Dept.
Lubbock, TX 79409-0002
(806) 742-2282 Fax: (806) 742-1920

UTAH

UTAH STATE UNIV.

Merrill Library Documents Dept.
Logan, UT 84322-3000
(801) 797-2678 Fax: (801) 797-2677

VIRGINIA

UNIV. OF VIRGINIA

Alderman Library
Govt. Documents
University Ave. & McCormick Rd.
Charlottesville, VA 22903-2498
(804) 824-3133 Fax: (804) 924-4337

WASHINGTON

WASHINGTON STATE LIBRARY

Govt. Publications
P.O. Box 42478
16th and Water Streets
Olympia, WA 98504-2478
(206) 753-4027 Fax: (206) 586-7575

WEST VIRGINIA

WEST VIRGINIA UNIV. LIBRARY

Govt. Documents Section
P.O. Box 6069 - 1549 University Ave.
Morgantown, WV 26506-6069
(304) 293-3051 Fax: (304) 293-6638

WISCONSIN

ST. HIST. SOC. OF WISCONSIN LIBRARY

Govt. Publication Section
816 State Street
Madison, WI 53706
(608) 264-6525 Fax: (608) 264-6520

MILWAUKEE PUBLIC LIBRARY

Documents Division
814 West Wisconsin Avenue
Milwaukee, WI 53233
(414) 286-3073 Fax: (414) 286-8074

Typical Report Citation and Abstract

- ❶ 19970001126 NASA Langley Research Center, Hampton, VA USA
- ❷ Water Tunnel Flow Visualization Study Through Poststall of 12 Novel Planform Shapes
- ❸ Gatlin, Gregory M., NASA Langley Research Center, USA Neuhart, Dan H., Lockheed Engineering and Sciences Co., USA; Mar. 1996; 130p; In English
Contract(s)/Grant(s): RTOP 505-68-70-04
- ❹ Report No(s): NASA-TM-4663; NAS 1.15:4663; L-17418; No Copyright; Avail: CASI; A07, Hardcopy; A02, Microfiche
- ❺ To determine the flow field characteristics of 12 planform geometries, a flow visualization investigation was conducted in the Langley 16- by 24-Inch Water Tunnel. Concepts studied included flat plate representations of diamond wings, twin bodies, double wings, cutout wing configurations, and serrated forebodies. The off-surface flow patterns were identified by injecting colored dyes from the model surface into the free-stream flow. These dyes generally were injected so that the localized vortical flow patterns were visualized. Photographs were obtained for angles of attack ranging from 10° to 50°, and all investigations were conducted at a test section speed of 0.25 ft per sec. Results from the investigation indicate that the formation of strong vortices on highly swept forebodies can improve poststall lift characteristics; however, the asymmetric bursting of these vortices could produce substantial control problems. A wing cutout was found to significantly alter the position of the forebody vortex on the wing by shifting the vortex inboard. Serrated forebodies were found to effectively generate multiple vortices over the configuration. Vortices from 65° swept forebody serrations tended to roll together, while vortices from 40° swept serrations were more effective in generating additional lift caused by their more independent nature.
- ❻ Author
- ❼ *Water Tunnel Tests; Flow Visualization; Flow Distribution; Free Flow; Planforms; Wing Profiles; Aerodynamic Configurations*

Key

1. Document ID Number; Corporate Source
2. Title
3. Author(s) and Affiliation(s)
4. Publication Date
5. Contract/Grant Number(s)
6. Report Number(s); Availability and Price Codes
7. Abstract
8. Abstract Author
9. Subject Terms

AERONAUTICAL ENGINEERING

A Continuing Bibliography (Suppl. 408)

OCTOBER 1999

01 AERONAUTICS

19990070423 Defence Science and Technology Organisation, Airframes and Engines Div., Melbourne, Australia

Workshop on Helicopter Health and Usage Monitoring Systems, Pt. 2

Forsyth, Graham F., Editor, Defence Science and Technology Organisation, Australia; March 1999; In English, Feb. 1999, Melbourne, Australia; See also 19990070424 through 19990070432

Report No.(s): DSTO-GD-0197-Pt-2; DODA-AR-010-839-Pt-2; Copyright; Avail: Issuing Activity (DSTO Aeronautical and Maritime Research Lab., PO Box 4331, Melbourne, Victoria 3001, Australia), Hardcopy, Microfiche

Over the last 10 years, helicopter Health and Usage Monitoring Systems (HUMS) have moved from the research environment to being viable systems for fitment to civil and military helicopters. In the civil environment, the situation has reached the point where it has become a mandatory requirement for some classes of helicopters to have HUMS fitted. Military operators have lagged their civil counterparts in implementing HUMS, but that situation appears set to change with a rapid increase expected in their use in military helicopters. A DSTO-sponsored Workshop was held in Melbourne, Australia, in February 1999 to discuss the current status of helicopter HUMS and any issues of direct relevance to military helicopter operations. This second part contains a list of those attending and a number of papers not received in time for publication before the event.

Author

Conferences; Health; Monitors

19990071044 Royal Aeronautical Society, London, UK

Verification of Design Methods by Test and Analysis: Proceedings

Verification of Design Methods by Test and Analysis: Proceedings; 1998; In English; Verification of Design Methods by Test and Analysis, 23-24 Nov. 1998, London, UK; See also 19990071045 through 19990071059; Original contains color illustrations; ISBN 1-85768-089-8; Copyright; Avail: Issuing Activity (The Royal Aeronautical Society, 4 Hamilton Place, London, W1V 0BQ, UK), Hardcopy, Microfiche

Contents include the following: Modelling of 3D aircraft inlets at "zero" speed (and low speeds with cross-wind) and flow separation prediction; Numerical and experimental studies of 3D hypersonic inlet; Design verification of turbomachinery components by 3D flow analysis; Forced response prediction in a high pressure ratio fan using a linearized method and comparison with test results; The effect of pressure probe characteristics on the validation of modelling aero-engine compressor blades; Low speed compressor tests for code validation and for simulating high speed designs; Validation of novel low-temperature fire event modelling technique; The numerical simulation and experimental validation of ventilation flow and fire events in a Trent Nacelle fire zone; Experimental simulation and numerical modelling of foreign object damage aircraft gas turbines; Elastic-plastic buckling of shafts; Towards reliable computations of a subsonic turbine; Experimental investigations into turbo engine designs; Validation of advanced computational fluid dynamics in the design of military turbines; and An evaluation of the performance of a modern shroudless HP turbine using unsteady CFD.

CASI

Conferences; Aircraft Engines; Compressor Blades; Turbomachinery; Computational Fluid Dynamics; Engine Design; Gas Turbine Engines; Mathematical Models; Computerized Simulation; Design Analysis

19990079747 Nanjing Univ. of Aeronautics and Astronautics, Nanjing, Jiangsu, China

Journal of Nanjing University of Aeronautics and Astronautics

Zhang, A.; Apr. 1999; Volume 31, No. 2; 136p; In Chinese; Portions of this document are not fully legible

Report No.(s): PB99-164550; No Copyright; Avail: National Technical Information Service (NTIS), Hardcopy

Contents include the following: Test Technology of Unsteady Aerodynamic Characteristic for a Model Oscillating in Large Amplitude Pitching-Rolling Motion; Using Genetic Algorithms for Optimum Shape Design of Nozzle; Simulation of Flow Field of Complicated Boundary by Using 2D-3D Combining Turbulent Model; Digital Generation of Two-Dimensional Field of Turbulence Based on Spatial Correlation Function; Direct Optimization Method of Uncertain Structural Systems Using Interval Analysis; Experimental Research on Enhancing Heat Transfer in Grinding Contact Zone with Jet Impinging During Intermittent Creep Feed Grinding; An Algorithm and Its Application for Polyline Clipping Based on Finite-Loop Domain; A Model of Tensile Residual Strength of FRP and Its Distribution; Implementation of D-S Evidential Theory in Multisensor Data Fusion System; Analysis of Sequencing Algorithms for Arrival Traffic in Terminal Area; Design and Simulation of a New Combinative Intelligence Flight Control System of Advanced Helicopter with Weapon; An Approach to the Object-Oriented Petri Net; Summarization; and Research Bulletins.

NTIS

Tensile Strength; Aerodynamic Characteristics; Object-Oriented Programming; Flow Distribution; Flight Control

19990080926 NASA Ames Research Center, Moffett Field, CA USA

Helicopter Flight Simulation Motion Platform Requirements

Schroeder, Jeffery Allyn, NASA Ames Research Center, USA; July 1999; 92p; In English

Contract(s)/Grant(s): RTOP 548-40-12

Report No.(s): NASA/TP-1999-208766; NAS 1.60:208766; A-9900432; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche

To determine motion fidelity requirements, a series of piloted simulations was performed. Several key results were found. First, lateral and vertical translational platform cues had significant effects on fidelity. Their presence improved performance and reduced pilot workload. Second, yaw and roll rotational platform cues were not as important as the translational platform cues. In particular, the yaw rotational motion platform cue did not appear at all useful in improving performance or reducing workload. Third, when the lateral translational platform cue was combined with visual yaw rotational cues, pilots believed the platform was rotating when it was not. Thus, simulator systems can be made more efficient by proper combination of platform and visual cues. Fourth, motion fidelity specifications were revised that now provide simulator users with a better prediction of motion fidelity based upon the frequency responses of their motion control laws. Fifth, vertical platform motion affected pilot estimates of steady-state altitude during altitude repositioning. Finally, the combined results led to a general method for configuring helicopter motion systems and for developing simulator tasks that more likely represent actual flight. The overall results can serve as a guide to future simulator designers and to today's operators.

Author

Flight Simulation; Helicopters; Estimates; Vertical Motion; Visual Stimuli; Yaw

02

AERODYNAMICS

Includes aerodynamics of bodies, combinations, wings, rotors, and control surfaces; and internal flow in ducts and turbomachinery.

19990071243 Kyushu Univ., Faculty of Engineering, Fukuoka, Japan

Principal Component Analysis of the Aerodynamic Forces Acting on an RPRV

Higashino, Shin-ichiro, Kyushu Univ., Japan; Ikematsu, Takashi, Kyushu Univ., Japan; Seto, Masayuki, Kyushu Univ., Japan; Sakurai, Akira, Kyushu Univ., Japan; Technology Reports of Kyushu University; Jun. 1994; ISSN 0023-2718; Volume 67, No. 3, pp. 209-217; In Japanese; No Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

We have been performing flight experiments using an RPRV (Remotely-Piloted Research Vehicle) in order to acquire the aerodynamic characteristics of the vehicle. The experiments and analyses are carried out under the concept of 'in-flight wind tunnel test' proposed by Kobavashi. It is shown that the principal component analysis is effective in finding out whether the multicollinearity between the motion variables exists or not. This analysis can also be used for the determination of the model for the aerodynamic characteristics.

Author

Aerodynamic Characteristics; Experiment Design; Flight Tests

19990077359 Chinese Inst. of Engineers, Taipei, Taiwan, Province of China

Systematic Study and Numerical Simulation of Sabot Projectile Aerodynamics

Lin, Huang, Chinese Inst. of Engineers, Taiwan, Province of China; Lai, Chun-Liang, Chinese Inst. of Engineers, Taiwan,

Province of China; Journal of The Chinese Institute of Engineers: Transactions of the Chinese Institute of Engineers, Series A; May 1997; ISSN 0253-3839; Volume 20, No. 3, pp. 275-284; In English; No Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

Numerical calculations based on a TVD method are employed in the present study to investigate systematically the flow field and pressure distribution around the armor piercing, discarding sabot projectile when just leaving the muzzle. The relevant parameters to be investigated are the free stream Mach number, cone angle, sabot position, sabot height, and sabot depth. Due to the specific geometry, there exists an oblique shock starting from the projectile tip and a bow shock in front of the sabot when the free stream velocity is supersonic. A circulatory flow region may also exist between the bow shock and the sabot. According to the numerical calculations, the strength of the bow shock becomes stronger with a larger free stream Mach number or a smaller cone angle. The bow shock will move forward with a larger sabot height. When the sabot is smaller in height or depth, the circulatory flow region will become smaller. Furthermore, a projectile with a smaller cone angle, a more rearward sabot position, a larger sabot height, or a larger sabot depth will be more conducive to the lift-off of the sabot.

Author

Sabot Projectiles; Aerodynamics; Mach Number; Mach Cones; Oblique Shock Waves; Bow Waves; Free Flow; Liftoff (Launching)

19990077760 Army Research Lab., Aberdeen Proving Ground, MD USA

Computational Modeling of a Segmented Projectile Final Report

Sahu, Jubaraj, Army Research Lab., USA; Heavey, Karen R., Army Research Lab., USA; Jun. 1999; 33p; In English

Contract(s)/Grant(s): DA Proj. 1L1-62618-AH-80

Report No.(s): AD-A365674; ARL-TR-1988; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This report describes the application of the chimera numerical technique to a multi-body segmented projectile configuration system of interest to the U.S. Army. Computations were performed at a supersonic speed on this configuration which consists of an ogive cylinder projectile with a peg shaped trailing segment. The computed results show the qualitative features of the wake flow field for the projectile with the segment in three different positions: centered, offset, and angled. The segment in the offset position has a strong effect on the flow field in the aft region of the projectile, thus affecting the aerodynamic coefficients of the projectile. The force and moment coefficients of the segment are also significantly affected by the orientation of the segment.

DTIC

Computational Grids; Grid Generation (Mathematics); Computational Fluid Dynamics; Projectiles; Ballistics; Ballistic Trajectories; Trajectory Analysis

19990079382 NASA Langley Research Center, Hampton, VA USA

X-33 Aerodynamic and Aeroheating Computations for Wind Tunnel and Flight Conditions

Hollis, Brian R., NASA Langley Research Center, USA; Thompson, Richard A., NASA Langley Research Center, USA; Murphy, Kelly J., NASA Langley Research Center, USA; Nowak, Robert J., NASA Langley Research Center, USA; Riley, Christopher J., NASA Langley Research Center, USA; Wood, William A., NASA Langley Research Center, USA; Alter, Stephen J., NASA Langley Research Center, USA; Prabhu, Ramadas K., Lockheed Martin Engineering and Sciences Co., USA; 1999; 18p; In English; Atmospheric Flight Mechanics, 9-11 Aug. 1999, Portland, OR, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA; Original contains color illustrations

Report No.(s): AIAA Paper 99-4163; Copyright; Avail: Issuing Activity, Hardcopy

This report provides an overview of hypersonic Computational Fluid Dynamics research conducted at the NASA Langley Research Center to support the Phase II development of the X-33 vehicle. The X-33, which is being developed by Lockheed-Martin in partnership with NASA, is an experimental Single-Stage-to-Orbit demonstrator that is intended to validate critical technologies for a full-scale Reusable Launch Vehicle. As part of the development of the X-33, CFD codes have been used to predict the aerodynamic and aeroheating characteristics of the vehicle. Laminar and turbulent predictions were generated for the X-33 vehicle using two finite-volume, Navier-Stokes solvers. Inviscid solutions were also generated with an Euler code. Computations were performed for Mach numbers of 4.0 to 10.0 at angles-of-attack from 10 deg to 48 deg with body flap deflections of 0, 10 and 20 deg. Comparisons between predictions and wind tunnel aerodynamic and aeroheating data are presented in this paper. Aeroheating and aerodynamic predictions for flight conditions are also presented.

Author

X-33 Reusable Launch Vehicle; Aerodynamic Heating; Computational Fluid Dynamics; Navier-Stokes Equation; Euler Equations of Motion; Finite Volume Method

19990080917 NASA Langley Research Center, Hampton, VA USA

Application of an Unstructured Grid Navier-Stokes Solver to a Generic Helicopter Body: Comparison of Unstructured Grid Results with Structured Grid Results and Experimental Results

Mineck, Raymond E., NASA Langley Research Center, USA; August 1999; 52p; In English

Contract(s)/Grant(s): RTOP 581-10-11-01

Report No.(s): NASA/TM-1999-209510; NAS 1.15:209510; L-17880; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

An unstructured-grid Navier-Stokes solver was used to predict the surface pressure distribution, the off-body flow field, the surface flow pattern, and integrated lift and drag coefficients on the ROBIN configuration (a generic helicopter) without a rotor at four angles of attack. The results are compared to those predicted by two structured-grid Navier-Stokes solvers and to experimental surface pressure distributions. The surface pressure distributions from the unstructured-grid Navier-Stokes solver are in good agreement with the results from the structured-grid Navier-Stokes solvers. Agreement with the experimental pressure coefficients is good over the forward portion of the body. However, agreement is poor on the lower portion of the mid-section of the body. Comparison of the predicted surface flow patterns showed similar regions of separated flow. Predicted lift and drag coefficients were in fair agreement with each other.

Author

Unstructured Grids (Mathematics); Pressure Distribution; Flow Distribution; Separated Flow; Pressure Ratio; Aerodynamic Drag

19990080939 Tokyo Univ., Faculty of Engineering, Japan

Experimental Study on Flow Over Spiked Hemisphere at Komaba Hypersonic Wind Tunnel

Kubota, Hiroto, Tokyo Univ., Japan; Watanuki, Tadaharu, Tokyo Univ., Japan; Matsumoto, Shinichi, Tokyo Univ., Japan; Fukui, Toshio, Tokyo Univ., Japan; Suenaga, Hisashi, National Aerospace Lab., Japan; Journal of the Faculty of Engineering the University of Tokyo series B; Mar. 1993; ISSN 0563-7937; Volume 62, pp. 65-71; In English; No Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

Flow observation and pressure distribution measurement for the hemisphere with sharp/blunt nosed spike are conducted at hypersonic wind tunnel in Komaba area (KOMHYP) of Mach number of 7. Flow structure is investigated by Schlieren photograph and characteristics of pressure distributions as well as level and location of peak pressure in variation with length of spike and shape of spike nose are studied in connection of flow structure. The obtained pressure distributions are compared favorably with results of numerical simulation,

Author

Experimentation; Simulation; Hypersonic Speed; Flow Characteristics

19990080965 NASA Langley Research Center, Hampton, VA USA

X-33 Hypersonic Aerodynamic Characteristics

Murphy, Kelly J., NASA Langley Research Center, USA; Nowak, Robert J., NASA Langley Research Center, USA; Thompson, Richard A., NASA Langley Research Center, USA; Hollis, Brian R., NASA Langley Research Center, USA; Prabhu, Ramadas K., Lockheed Martin Engineering and Sciences Co., USA; 1999; 16p; In English; Atmospheric Flight Mechanics, 9-11 Aug. 1999, Portland, OR, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA

Report No.(s): AIAA Paper 99-4162; Copyright; Avail: Issuing Activity, Hardcopy

Lockheed Martin Skunk Works, under a cooperative agreement with NASA, will build and fly the X-33, a half-scale prototype of a rocket-based, single-stage-to-orbit (SSTO), reusable launch vehicle (RLV). A 0.007-scale model of the X-33 604B0002G configuration was tested in four hypersonic facilities at the NASA Langley Research Center to examine vehicle stability and control characteristics and to populate an aerodynamic flight database in the hypersonic regime. The vehicle was found to be longitudinally controllable with less than half of the total body flap deflection capability across the angle of attack range at both Mach 6 and Mach 10. At these Mach numbers, the vehicle also was shown to be longitudinally stable or neutrally stable for typical (greater than 20 degrees) hypersonic flight attitudes. This configuration was directionally unstable and the use of reaction control jets (RCS) will be necessary to control the vehicle at high angles of attack in the hypersonic flight regime. Mach number and real gas effects on longitudinal aerodynamics were shown to be small relative to X-33 control authority.

Author

X-33 Reusable Launch Vehicle; Single Stage to Orbit Vehicles; Hypersonic Flight; Hypersonic Speed; Spacecraft Configurations; Launch Vehicle Configurations; Aerodynamic Configurations; Aerodynamic Characteristics

19990080968 NASA Langley Research Center, Hampton, VA USA

Large-Eddy Simulations and Lidar Measurements of Vortex-Pair Breakup in Aircraft Wakes

Lewellen, D. C., West Virginia Univ., USA; Lewellen, W. S., West Virginia Univ., USA; Poole, L. R., NASA Langley Research Center, USA; DeCoursey, R. J., Science Applications International Corp., USA; Hansen, G. M., Science and Technology Corp., USA; Hostetler, C. A., NASA Langley Research Center, USA; Kent, G. S., Science and Technology Corp., USA; AIAA Journal; August 1998; Volume 36, No. 8, pp. 1439-1445; In English

Contract(s)/Grant(s): NAG1-1635; Copyright; Avail: Issuing Activity, Hardcopy

Results of large-eddy simulations of an aircraft wake are compared with results from ground-based lidar measurements made at NASA Langley Research Center during the Subsonic Assessment Near-Field Interaction Flight Experiment field tests. Brief reviews of the design of the field test for obtaining the evolution of wake dispersion behind a Boeing 737 and of the model developed for simulating such wakes are given. Both the measurements and the simulations concentrate on the period from a few seconds to a few minutes after the wake is generated, during which the essentially two-dimensional vortex pair is broken up into a variety of three-dimensional eddies. The model and experiment show similar distinctive breakup eddies induced by the mutual interactions of the vortices, after perturbation by the atmospheric motions.

Author

Large Eddy Simulation; Radar Measurement; Computational Fluid Dynamics; Turbulence Models; Turbulent Flow; Vortex Breakdown; Vortices

19990081085 NASA Langley Research Center, Hampton, VA USA

Global Nonlinear Parametric Modeling with Application to F-16 Aerodynamics

Morelli, Eugene A., NASA Langley Research Center, USA; 1998; 6p; In English; American Control Conference, 24-26 Jun. 1998, Philadelphia, PA, USA

Report No.(s): ACC Paper ID-i-98010-2; No Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

A global nonlinear parametric modeling technique is described and demonstrated. The technique uses multivariate orthogonal modeling functions generated from the data to determine nonlinear model structure, then expands each retained modeling function into an ordinary multivariate polynomial. The final model form is a finite multivariate power series expansion for the dependent variable in terms of the independent variables. Partial derivatives of the identified models can be used to assemble globally valid linear parameter varying models. The technique is demonstrated by identifying global nonlinear parametric models for nondimensional aerodynamic force and moment coefficients from a subsonic wind tunnel database for the F-16 fighter aircraft. Results show less than 10% difference between wind tunnel aerodynamic data and the nonlinear parameterized model for a simulated doublet maneuver at moderate angle of attack. Analysis indicated that the global nonlinear parametric models adequately captured the multivariate nonlinear aerodynamic functional dependence.

Author

Nonlinearity; Aerodynamics; Models; Force Distribution; Procedures; Wind Tunnel Tests; Aerodynamic Forces

19990081122 Joint Inst. for Advancement of Flight Sciences, Hampton, VA USA

Investigation of a Technique for Measuring Dynamic Ground Effect in a Subsonic Wind Tunnel

Graves, Sharon S., Joint Inst. for Advancement of Flight Sciences, USA; August 1999; 66p; In English

Contract(s)/Grant(s): NCC1-24; RTOP 537-07-51

Report No.(s): NASA/CR-1999-209544; NAS 1.26:209544; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

To better understand the ground effect encountered by slender wing supersonic transport aircraft, a test was conducted at NASA Langley Research Center's 14 x 22 foot Subsonic Wind Tunnel in October, 1997. Emphasis was placed on improving the accuracy of the ground effect data by using a "dynamic" technique in which the model's vertical motion was varied automatically during wind-on testing. This report describes and evaluates different aspects of the dynamic method utilized for obtaining ground effect data in this test. The method for acquiring and processing time data from a dynamic ground effect wind tunnel test is outlined with details of the overall data acquisition system and software used for the data analysis. The removal of inertial loads due to sting motion and the support dynamics in the balance force and moment data measurements of the aerodynamic forces on the model is described. An evaluation of the results identifies problem areas providing recommendations for future experiments. Test results are validated by comparing test data for an elliptical wing planform with an Elliptical wing planform section with a NACA 0012 airfoil to results found in current literature. Major aerodynamic forces acting on the model in terms of lift curves for determining ground effect are presented. Comparisons of flight and wind tunnel data for the TU-144 are presented.

Author

Ground Effect (Aerodynamics); Aerodynamic Forces; Subsonic Wind Tunnels; Wind Tunnel Tests; Data Acquisition; Aircraft Design; Aerodynamic Configurations; Aircraft Configurations

19990084093 NASA Langley Research Center, Hampton, VA USA

Imaging Supersonic Aircraft Shock Waves

Weinstein, Leonard M., NASA Langley Research Center, USA; Stacy, Kathryn, NASA Langley Research Center, USA; Vieira, Gerald J., NASA Wallops Flight Facility, USA; Haering, Edward A., Jr., NASA Dryden Flight Research Center, USA; Bowers, Albion H., NASA Dryden Flight Research Center, USA; Journal of Flow Visualization and Image Processing; 1997; Volume 4, pp. 189-199; In English; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

A schlieren imaging system that uses the sun as a light source was developed to obtain direct flow-field images of shock waves of aircraft in flight. This system was used to study how shock waves evolve to form sonic booms. The image quality obtained was limited by several optical and mechanical factors. Converting the photographs to digital images and applying digital image-processing techniques greatly improved the final quality of the images and more clearly showed the shock structures.

Author

Image Processing; Supersonic Aircraft; Shock Waves; Imaging Techniques

03

AIR TRANSPORTATION AND SAFETY

Includes passenger and cargo air transport operations; and aircraft accidents.

19990070409 Nebraska Univ., Aviation Inst., Omaha, NE USA

The Conference Proceedings of the 1998 Air Transport Research Group (ATRG) of the WCTR Society, Volume 3

Oum, Tae Hoon, Editor, British Columbia Univ., Canada; Bowen, Brent D., Editor, Nebraska Univ., USA; The Conference Proceedings of the 1998 Air Transport Research Group (ATRG) of the WCTR Society; December 1998; 228p; In English; 8th; 1998 Air Transport Research Group (ATRG) Conference of the WCTR Society, 12-17 Jul. 1998, Antwerp, Belgium; Sponsored by World Conference on Transportation Research Society; See also 19990070410 through 19990070422

Contract(s)/Grant(s): NAGw-4414

Report No.(s): UNOAI-98-8; Copyright Waived; Avail: CASI; A11, Hardcopy; A03, Microfiche

Thirteen papers (presentations) from the 8th World Conference on Transportation Research are presented. Topics include European Airline competition, cost analyses, performance evaluations, deregulation; aviation policy in Southeast Asia; corporate involvement in European business transportation; and cycles in the airline industry.

CASI

Conferences; Air Transportation; Airline Operations

19990070410 Universidad de Las Palmas de Gran Canaria, Dept. of Applied Economical Analysis, Las Palmas, Spain

Implications of Competition in the European Airline Market

Martin, Juan Carlos, Universidad de Las Palmas de Gran Canaria, Spain; Nombela, Gustavo, Universidad de Las Palmas de Gran Canaria, Spain; Romero, Manuel, Universidad de Las Palmas de Gran Canaria, Spain; The Conference Proceedings of the 1998 Air Transport Research Group (ATRG) of the WCTR Society; December 1998; Volume 3; 20p; In English; See also 19990070409 Contract(s)/Grant(s): CEC Project ST-95-SC-402; Copyright Waived; Avail: CASI; A03, Hardcopy; A03, Microfiche

As a consequence of limiting the possibility of new entrants in the market because of the privileges that flag incumbent airlines enjoy in their airports of their influence, there is only a 6% of the continental routes that can be considered as competitive according to our own definition of competition in the estimation of the models, and this one it is not too stringent. In this case we have shown that the demand is below the levels that could be achieved by the likely monopoly power that is exerted by the pairs of national flag carriers. In particular, it is necessary to develop a transparent policy trying to establish the common-user access rights to the principal airport of the E.U. The analysis shows that we have more goals to get by introducing initiatives to obtain more competition in the routes and at the same time it is clear that competition is possible and desirable to some extent. The airport at Brussels has the same landing capacity as London's Heathrow, but only half of the traffic. Its refusal to create new landing slots, on grounds that there is not enough room, is a serious barrier to entry that can be exploited by Sabena, Belgium's national airline. In addition, some new entrants airlines complain that in many cases the handling labour of the airports favour the national carrier. An E.U. directive 96/67/CE from 1996 intended to prevent monopolies in airport services, but this directive in some experts' opinions has been watered down by the member states to the point where it will achieve virtually nothing. Swifter justice and a stronger directive on airport services would do much to help new entrants. to give newcomers a chance to break into new routes, the Commission needs to create a proper market in slots. In spite of the previous paragraphs we cannot minimise the real advantages and benefits that European citizens enjoy in these years after deregulation, and that the real change is going to be observed in the future after this year 1997, when we can say that the complete market deregulation is fulfilled. The paper that can

be played by the companies that till now have developed their strategic movements to the competitive segment of regional and charter services can be higher than the expectations that have been said by some analysts. Cross entry and the signature of contracts with some companies can change the nowadays' network, and some low-priced services can emerge from this new situation.

Author

Civil Aviation; Airline Operations; Competition; Market Research

19990070411 Paris Univ., France

Priorities and Strategy for Liberalisation in the European Airlines

Briand, Sophie, Paris Univ., France; Kelvin, Alex, Hertfordshire Univ., UK; The Conference Proceedings of the 1998 Air Transport Research Group (ATRG) of the WCTR Society; December 1998; Volume 3; 10p; In English; See also 19990070409; Copyright Waived; Avail: CASI; A02, Hardcopy; A03, Microfiche

The purpose of this paper was to outline priorities for liberalising European air transport. Although the empirical evidence from the US air industry has not fully supported all contestability assumptions, prices have fallen, networks have expanded, and the customers have benefited. More slots have been created and competition increased. Both price and quality of service appear to be better in America than in more regulated markets. Similarly, the increased competition in the UK has improved services. Up to the 1990s, the Liberalisation of air transport in Europe did not seem very effective. Protection of the incumbent public airlines appears to be detrimental to the customers and the taxpayers. But while competition is on the rise, some governments still continue subsidising their national carriers, e.g., Air France. The sheltered markets exist in quite a number of countries. They result in redistribution of consumer surplus to the providers of air services. However, successful companies use market segmentation and positioning to match supply and demand. Under pressures of Liberalisation, there is a definite move towards globalisation. With over 400 alliances worldwide, the industry is changing to meet the needs of global market. Priorities for liberalisation were outlined such as removal of restrictions on route access and capacity related to the carriers' nationality, ending national public monopolies over air transport. Private companies or partnerships appear to provide services at lower financial costs, transaction costs and social costs. The customers express preferences for widening the choice of competing companies. In liberalised markets, the regulatory authorities need to prevent predatory pricing and price collusion, maintain high safety standards, make obligatory insurance arrangements to compensate the customers in case of airlines going bankrupt. Regulation would safeguard the fair allocation of slots. Mechanisms are needed to ensure that the customers' and environmentalists' views are adequately represented in decision-making. It is most encouraging that the customers are reaping rewards.

Derived from text

Air Transportation; Civil Aviation; Market Research; Competition

19990070412 Universidad de Las Palmas de Gran Canaria, Dept. of Economic Analysis, Las Palmas, Spain

European Air Transport Deregulation (1986-1994): A Panel Data Approach

Betancor, Ofelia, Universidad de Las Palmas de Gran Canaria, Spain; Campos, Javier, Universidad de Las Palmas de Gran Canaria, Spain; The Conference Proceedings of the 1998 Air Transport Research Group (ATRG) of the WCTR Society; December 1998; Volume 3; 20p; In English; See also 19990070409

Contract(s)/Grant(s): CEC Project ST-96-SC-172; Copyright Waived; Avail: CASI; A03, Hardcopy; A03, Microfiche

In this note we have carried out an empirical assessment of the effects of deregulation on the pricing policies of the European air industry from 1986 to 1994 for the scheduled passengers traffic. Our basic unit of analysis is the city-pair route, since we also consider this as the basic unit of competition for this sort of traffic. Two types of deregulation effects have been modelled. First, strict route-deregulation effect, according to the existence or not of liberal bilateral agreements between the countries involved in any single route. Second, a pure time-deregulation effect, according to the progressive influence of the European Commission deregulation packages that came into place at years 1987, 1990 and 1992. To capture these effects we compare different price definitions over forty-four different international intra-European routes consecutively observed for nine years. In order to make the comparison valuable, we control not only by deregulation variables, but also by several supply and demand variables, such as passengers-kms, number of flights, distance, load factor and per head income. We also control by unobservable individual effects that may possibly affect the validity of the estimated coefficients. In terms of fares in levels we can only confirm that the basic standard fare (Y-fare) is around a 7 percent lower in those routes where liberal bilaterals are in force, whilst the SPEX-fare would be similar. With respect to other fares our econometric results are not conclusive. Once special features of routes are bore in mind including fixed effects, it happens that the effect of liberal bilaterals in Europe seems to be very weak. When percentages of discount with respect to the Economy fare are calculated, we have surprisingly found that these are always lower in routes subject to liberal bilaterals, but for the E-fare. There is also an important difference between the PEX and SPEX-fare in terms of the European liberalisation process. The discount applied to the former has been increasing, at at some points in time, though the trend for the last is to experienced lower percentages mainly at the beginning of the period. Thus the impact of the European

deregulation process, if any, has not been the same as the one exerted by liberal bilateral agreements. However, the most striking impact of such bilateral agreements has been the proliferation of tariffs, allowing to choose among a greater range of fares that could be now on passengers average 87 percent higher. Airlines are nowadays working with a greater number of discounted fares, this might also indicate they could be now getting lower yields if these tariffs were actually widely available in terms of seats being offered on a discount basis. This information is not published in Europe, however significance of the load factor parameter and relevant literature for the USA case (Keeler, 1991) would support it. In relation to the European deregulation packages, it is also the case that effects on levels of fares have been negligible so far. Again, its impact is found in the greater number of fares that are now available to passengers. In conclusion, our work shows that the effects of the air transport deregulation process in Europe have been much more gradual than other non-European experiences. This is so because the European process has been phased in over a lengthy period and the nature and the intensity of government intervention varied enormously between different countries. This makes that the first two years of the Single Market (1993-1994) had not seen a uniform flourishing of competition across the European Union, either between the major carriers or from new entrants or existing smaller airlines. However there is one caveat to our conclusions and an important starting point for future work. Since European airlines' yields by route are not publicly available we have restricted our econometric analysis only to four types of fares. For none of these variables, competition in European skies has taken the form of generalised price decreases as a result from the application of liberal bilateral agreements or the European deregulation process itself. However, we have found an important impact in terms of a newer and wider catalogue of fares among which passengers could better accommodate their preferences. Only if these are also widely available for most flights would airline deregulation have improved matters.

Derived from text

Air Transportation; Europe; Airline Operations; Policies; Agreements

19990070413 Universidad de Las Palmas de Gran Canaria, Las Palmas, Spain

European Airline Industry: A Cost Analysis and Economic Performance Evaluation

Martin, Juan Carlos, Universidad de Las Palmas de Gran Canaria, Spain; Nombela, Gustavo, Universidad de Las Palmas de Gran Canaria, Spain; Romero, Manuel, Universidad de Las Palmas de Gran Canaria, Spain; The Conference Proceedings of the 1998 Air Transport Research Group (ATRG) of the WCTR Society; December 1998; Volume 3; 23p; In English; See also 19990070409 Contract(s)/Grant(s): CEC Project ST-95-SC-402; Copyright Waived; Avail: CASI; A03, Hardcopy; A03, Microfiche

The European liberalisation process in the air industry has changed the conditions for carriers to operate in this market. Before this, it was a market where limitations to competition existed as in the domestic markets where in many cases there was a legal monopoly, or in the intraeuropean market where airlines operated with bilateral agreements between states to share the market. The three liberalisation packages have eliminated the legal barriers to competition to established a situation of complete freedom of entry and exit for European carriers in any domestic or intrastate market, into the philosophy of the Treaty of Rome. In this paper we study cost structure of air carriers with the main objective of analysing how the liberalisation process has affected efficiency in the production of European companies. by studying the existence of economies of scale in the industry, we can try to predict how the companies of this sector will response to the measures of the Commission. The main question to answer is if the size of the air carriers can affect to efficiency gains in costs and production. Market structure can be affected by existence of economics of scale in the market which could bring possible tendencies of concentration in the market, and that could be answer to the bilateral agreements, joint ventures and acquisitions that can be observed actually between air carriers along European market. Section 2 describes the sample of 22 airlines, 13 from Europe and 9 from North America for a period of six years since 1991 to 1995, that has been used to carry out this study. Data has been obtained from ICAO and IATA publications. Section 3 presents a parametric analysis as an approach to analyse the efficiency of airlines. So for the period 1990-95 there still exists a gap between the performance of European airlines and their American counterparts, both in terms of productivity and unit costs. Although it can be observed that European are covering in terms of costs to American levels. Although for the characteristics of output in air transport it might be estimated a desegregated cost function, the absence of information to make this have lead us to estimate an aggregated translogarithmical cost function. As a consequence, its necessary to define correctly what is understood by economies of scale and how to determine it from an aggregated cost function. Section 4 presents an Econometric analysis carry out to estimate a cost function for the industry. The use of translogarithmical cost function specification and the cost share equations is used as a standard methodology to estimate transport cost. This is because is the easiest to estimate and interpret (the arguments of the function are in logarithms). The disadvantage comes from the number of coefficients to estimate. The analysis of economies of scale with the traditional form and corrected following Jara and Cortes (1996) and Oum and Zhang (1997) are compared in section 5. So the presence of economies of scale is notably reinforced if the correction of the effect of changes in output and network over other exogenous factors proposed is performed. Also in this section cost complementarity and the effect

of public and private ownership is analysed. Finally residuals obtained from the estimated cost function are used to estimate the potential cost reductions that inefficient airlines may achieve. Section 6 presents the main conclusions of this paper.

Derived from text

Europe; Air Transportation; Cost Analysis; Economic Analysis; Market Research

19990070414 British Columbia Univ., Faculty of Commerce and Business Administration, Vancouver, British Columbia Canada
Overview of Regulatory Changes in International Air Transport and Asian Strategies Towards the U.S. Open Skies Initiatives

Oum, Tae Hoon, Editor, British Columbia Univ., Canada; The Conference Proceedings of the 1998 Air Transport Research Group (ATRG) of the WCTR Society; December 1998; Volume 3; 17p; In English; See also 19990070409; Copyright Waived; Avail: CASI; A03, Hardcopy; A03, Microfiche

This paper identifies major issues facing Asian airlines and governments when they deal with the U.S. open skies initiatives directed towards Asian countries, and suggests how they might deal with those issues strategically and practically. The paper is organized as follows: Section I is a brief history of international air services regulation including the recent US initiatives for open skies and creation of European single aviation market. Section II identifies some key problems associated with traditional air services treaty negotiations. Key lessons from the US-Canada Open Skies agreement are described in Section III. Section IV identifies major challenges that the US open skies initiatives bring to Asian carriers with governments. Section V describes the suggested strategies for Asian carriers and governments to deal with the US open skies initiatives. The paper ends with a summary and conclusions.

Author

Air Transportation; Civil Aviation; Agreements; International Cooperation

19990070415 Sydney Univ., Inst. of Transport Studies, Australia

Aviation Policy in South East Asia: Alliances, "Open Skies" Bilaterals and Regional Airline Markets

Hooper, Paul, Sydney Univ., Australia; Duangphastra, Chakrit, Sydney Univ., Australia; The Conference Proceedings of the 1998 Air Transport Research Group (ATRG) of the WCTR Society; December 1998; Volume 3; 15p; In English; See also 19990070409; Copyright Waived; Avail: CASI; A03, Hardcopy; A03, Microfiche

Regionalism is not a force that acts alone. It has been pointed out that the Latin American airlines see the Mercosur regional airline market as an opportunity to develop markets as they cope with the pressure of competition from the major US carriers under liberal bilateral agreements. In Asia, the USA has concluded several open skies agreements and its carriers now enjoy opportunities to carry intra-regional traffic on more advantageous terms than the airlines based in the region (Findlay et al., 1997). One way to counter this is to enter into liberal bilateral agreements with each other. New Zealand and Singapore already have done this. The formation of regional aviation markets takes this a step further. However, the USA becomes a de facto member of the groups where it has signed its open skies bilaterals with the significant partners. This is a factor that could lead to a more open approach to membership of the regional groups. Bowen (1997) argues that the US open skies agreements are a progressive step in an opening salvo to liberalise the transpacific market in the same way the Atlantic was Liberalised in the mid-1990's. Much will depend, though, on the way the governments in South East Asia respond to the open skies agreements and in the way they cope with their current economic problems and the pressure that these are placing on their airlines.

Derived from text

Market Research; Civil Aviation; Air Transportation; Policies; Agreements; International Cooperation

19990070416 Korea Transport Inst., Seoul, Korea, Republic of

An Economic Effect of Duopoly Competition in International Airline Industry: The Case of Korea

Kim, Jongseok, Korea Transport Inst., Korea, Republic of; The Conference Proceedings of the 1998 Air Transport Research Group (ATRG) of the WCTR Society; December 1998; Volume 3; 12p; In English; See also 19990070409; Copyright Waived; Avail: CASI; A03, Hardcopy; A03, Microfiche

There are two types of international routes in and out of Korea. One is single-tracked route where only one Korean carrier operates, and the other is double-tracked route where both of Korean carriers operate simultaneously. In this paper, we analyze whether there is a price competition between the two Korean carriers and thus whether single and double tracked routes show difference in price performance. On the basis of the analysis, we calculate how much passengers are benefited due to price competition.

Author

Air Transportation; Competition; Economics; South Korea

19990070417 Plymouth Univ., Center for International Shipping and Transport, Plymouth, UK

Corporate Involvement in the Short Haul Business Travel Market in the European Union

Mason, Keith J., Plymouth Univ., UK; The Conference Proceedings of the 1998 Air Transport Research Group (ATRG) of the WCTR Society; December 1998; Volume 3; 18p; In English; See also 19990070409; Copyright Waived; Avail: CASI; A03, Hardcopy; A03, Microfiche

This paper has provided additional information regarding the business traveller and his/her employing organization in the purchase of air travel. The scale for traveller attitudes towards corporate travel policies (CTPs) can be evaluated by its application in other markets. Other attitude statements could be developed that might gain greater insight into business traveller attitude constructs. The scale for purchase attributes which was previously developed has been assessed and surprisingly similar results were found in terms of the key purchase attributes in the short haul business travel market which provides strong evidence of the key purchase benefits sought by the business travel market. A new market segmentation based on these product elements reaped further insight into the market and how it has changed in the last five years.

Derived from text

Market Research; Industries; Commerce; Europe; Air Transportation

19990070418 Korea Aviation Univ., Dept. of Aviation Management, Go-Yang, Korea, Republic of

Econometric Analysis of Airlift Passenger Demand

Yoon, Suk-Hong, Korea Aviation Univ., Korea, Republic of; The Conference Proceedings of the 1998 Air Transport Research Group (ATRG) of the WCTR Society; December 1998; Volume 3; 16p; In English; See also 19990070409; Copyright Waived; Avail: CASI; A03, Hardcopy; A03, Microfiche

This research reviews current airlift demand forecast models and refines them in accordance with the analysis methods of econometrics.

Derived from text

Air Transportation; Forecasting; Demand (Economics); Models; Econometrics

19990070419 Santander Univ., Cantabria, Dept. of Economics, Santander, Spain

Passenger's Choice of Air Transport Under Road Competition: The Use of Cointegration Techniques

Pablo, Coto-Millan, Santander Univ., Cantabria, Spain; Banos-Pino, Jose, Universidad de Oviedo, Spain; Inglada, Vicente, Ministerio de Obras Publicas, Spain; The Conference Proceedings of the 1998 Air Transport Research Group (ATRG) of the WCTR Society; December 1998; Volume 3; 12p; In English; See also 19990070409

Contract(s)/Grant(s): DGICYT-PS95-0095; Copyright Waived; Avail: CASI; A03, Hardcopy; A03, Microfiche

In this study we present a theoretical model for passenger air transport demands in Spain. Quarterly data has been used for the 1980.I-1992.IV period. We have used cointegration techniques, which are subject to a wide range of tests, to obtain short- and long-run equations. Moreover, we have obtained the product price and cross elasticities of each mode of transport. These estimations may be used to analyze the effects of transport fares on income changes, as well as to predict short- and long-run traffic.

Author

Air Transportation; Mathematical Models; Urban Transportation; Rail Transportation; Demand (Economics)

19990070420 Westminster Univ., Transport Studies Group, London, UK

Competition Between Hub Airports in Europe and a Methodology for Forecasting Connecting Traffic

Dennis, Nigel P. S., Westminster Univ., UK; The Conference Proceedings of the 1998 Air Transport Research Group (ATRG) of the WCTR Society; December 1998; Volume 3; 20p; In English; See also 19990070409

Report No.(s): Paper-74-Rev; Copyright Waived; Avail: CASI; A03, Hardcopy; A03, Microfiche

This paper considers the extent to which hub airports in Europe compete for transfer traffic and the performance of the major airlines. The relationship with scheduling issues, airport facilities and geographical constraints is addressed. A method for estimating changes in transfer traffic under changes in service or infrastructure provision is suggested. Some possible future developments of hubbing in Europe are considered, with particular reference to the shortage of runway capacity at many of Europe's major airports.

Derived from text

Air Transportation; Competition; Air Traffic; Europe

19990070421 Ecole Nationale de l'Aviation Civile, Toulouse, France

Cycles in the Air Transportation Industry

Lenoir, Nathalie, Ecole Nationale de l'Aviation Civile, France; The Conference Proceedings of the 1998 Air Transport Research

Group (ATRG) of the WCTR Society; December 1998; Volume 3; 15p; In English; See also 19990070409; Copyright Waived; Avail: CASI; A03, Hardcopy; A03, Microfiche

The aim of this paper to analyze aviation cycles by using statistical methods, and from there to build a model of airline behavior, using a game theory framework, to account for observed reactions in cycles. The outline of the paper is the following: First the theory of economic cycles is briefly reviewed (part 2). Then, using long time series data on world GDP and traffic, the link between economic cycles and traffic is discussed (part 3), as well as the relevance of other indicators. In the fourth part, relations and time lags between relevant aviation activity variables are studied and their relations with economic cycles discussed. Finally (part 5), a game theory framework is used to give an explanation of the airlines behavior, which results in an amplification of economic cycles in the airline industry. We conclude by suggesting ways of smoothing the cycles through a better management of capacity investments. Can the aviation cycle be broken?

Derived from text

Air Transportation; Cycles; Economics; Game Theory; Civil Aviation

19990070422 Thrace Univ., Section of Transportation, Xanthe, Greece

A Model for the Forecast of Demand in Major Touristic Airports: The Case of the Airport of Rhodes

Profillidis, V., Thrace Univ., Greece; The Conference Proceedings of the 1998 Air Transport Research Group (ATRG) of the WCTR Society; December 1998; Volume 3; 25p; In English; See also 19990070409; Copyright Waived; Avail: CASI; A03, Hardcopy; A03, Microfiche

Models of forecast of demand of airports have focused for years on busy central airports. However, touristic airports with high seasonalities present an increasing interest. The appropriate models for demand forecast for such touristic airports are analyzed in this paper: statistical, time-series, econometric, gravity and fuzzy models. Application of the models are presented for the case of a major airport of Eastern Mediterranean, the airport of Rhodes. The impact of the method of forecast in the airport master planning is also discussed.

Author

Airport Planning; Forecasting; Mathematical Models; Demand (Economics); Tourism

19990071172 Aerospace Corp., Technology Operations, El Segundo, CA USA

Natural and Triggered Lightning Launch Commit Criteria (LCC)

Krider, E. P.; Koons, H. C.; Walterscheid, R. L.; Rust, W. D.; Willett, J. C.; Jan. 15, 1999; 23p; In English

Contract(s)/Grant(s): F04701-93-C-0094

Report No.(s): AD-A365329; TR-99(1413)-1; SMC-TR-99-20; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This document has been prepared to document the Lightning Launch Commit Criteria recommended by the Lightning Advisory Panel (LAP) in May 1998. The LAP is a joint AF/NASA panel that provides an independent scientific assessment of, advice on, and recommended changes to the Lightning Launch Commit Criteria, lightning-related issues in the Flight Rules, and Lightning Advisories/Warnings for ground operations.

DTIC

Lightning; Launching

19990071581 Federal Aviation Administration, Atlantic City, NJ USA

Proposed Selection Criteria for Aviation Safety Analytical Methods and Tools

Press, Jacques; Jun. 1999; 21p; In English

Report No.(s): AD-A365209; DOT/FAA/CT-TN99/16; No Copyright; Avail: CASI; A01, Microfiche; A03, Hardcopy

This report provides a set of criteria useful in choosing and using analytical tools and methods (artifacts) directed at aviation safety analysis. The approach consists of adopting a rational framework in three selection stages: artifact classification, value, and quality. Furthermore, we have supplied a scoring and weighting method as an example. Over the years, experts have devised numerous analytical artifacts to articulate safety data into a comprehensive body of knowledge. Given the seriousness of aviation safety, we believe all such artifacts need to be evaluated wisely and cautiously before any claims are made. The criteria prescribed in this report provide one way to classify and evaluate them consistently, as a prelude to their use.

DTIC

Numerical Analysis; Aircraft Safety; Safety Factors; Flight Safety

19990071646 NASA Langley Research Center, Hampton, VA USA

Synthetic Vision Workshop 2

Kramer, Lynda J., Compiler, NASA Langley Research Center, USA; March 1999; 391p; In English; 2nd; Synthetic Vision

Workshop, 27-29 Jan. 1998, Hampton, VA, USA; Sponsored by NASA, USA

Contract(s)/Grant(s): RTOP 522-19-11-01

Report No.(s): NASA/CP-1999-209112; L-17838; NAS 1.55:209112; No Copyright; Avail: CASI; A17, Hardcopy; A04, Microfiche

The second NASA sponsored Workshop on Synthetic/Enhanced Vision (S/EV) Display Systems was conducted January 27-29, 1998 at the NASA Langley Research Center. The purpose of this workshop was to provide a forum for interested parties to discuss topics in the Synthetic Vision (SV) element of the NASA Aviation Safety Program and to encourage those interested parties to participate in the development, prototyping, and implementation of S/EV systems that enhance aviation safety. The SV element addresses the potential safety benefits of synthetic/enhanced vision display systems for low-end general aviation aircraft, high-end general aviation aircraft (business jets), and commercial transports. Attendance at this workshop consisted of about 112 persons including representatives from industry, the FAA, and other government organizations (NOAA, NIMA, etc.). The workshop provided opportunities for interested individuals to give presentations on the state of the art in potentially applicable systems, as well as to discuss areas of research that might be considered for inclusion within the Synthetic Vision Element program to contribute to the reduction of the fatal aircraft accident rate. Panel discussions on topical areas such as databases, displays, certification issues, and sensors were conducted, with time allowed for audience participation.

Author

Conferences; Enhanced Vision; Aircraft Safety; Display Devices; Flight Safety

19990071656 International Centre for Aviation and the Environment, Montreal, Quebec Canada

Survey of Nonglycol and Reduced Glycol Aircraft Deicing Methods Final Report

Cornish, J.; Eyre, F.; Apr. 1999; 74p; In English

Report No.(s): PB99-153967; DOT/FAA/AR-99/18; No Copyright; Avail: CASI; A01, Microfiche; A04, Hardcopy

This survey of no glycol and low-glycol deicing practices, methods, and procedures used by the world's airlines, including cargo carriers, was conducted under contract to the Federal Aviation Administration (FAA) William J. Hughes Technical Center. A representative sample of 80 of the world's airlines and airports with operations under winter ground icing conditions were surveyed by mail for their experience with no glycol or reduced-glycol deicing methods. Twenty-five responded. The results are presented in descriptive format for each of the procedures identified along with sample illustrations where appropriate. A summary is given of the principle characteristics for each procedure. Although the focus of the survey was the procedures in use, a number of technologies under development and which have been field tested have been included, such as truck-mounted blown air systems, mobile infrared heaters, and preheating of fuel prior to refueling.

NTIS

Glycols; Deicers; Civil Aviation

19990072345 Federal Aviation Administration, Administration Technical Center, Atlantic City, NJ USA

Evaluation of Oxygen Cylinder Overpacks Exposed to Elevated Temperature

Marker, T. R.; Diaz, R.; Jun. 1999; 26p; In English

Report No.(s): PB99-156853; DOT/FAA/AR-TN98/30; No Copyright; Avail: CASI; A01, Microfiche; A03, Hardcopy

Tests were conducted inside a large industrial convection furnace to determine the temperature and time required to cause pressure relief activation of three different size oxygen cylinders commonly used in commercial transport aircraft. The cylinders were first emptied of gaseous oxygen for safety reasons and refilled with nitrogen to the original pressure. The furnace temperature was ramped to 400 F, which represented the temperature reached during a Halon 1301 suppressed deep-seated cargo compartment fire. Cylinder pressure relief activation typically occurred after the surface temperature had reached only 300 F. Additional tests were conducted using a 76.5-cubic-foot oxygen cylinder placed inside several types of cylinder cases, commonly referred to as overpacks. The tests were run to determine the level of thermal protection, if any, that the overpacks might provide when the cylinders are subjected to elevated temperatures. Two custom-made overpacks were also tested that contained insulated materials aimed specifically at providing thermal protection. Tests showed that some common overpacks have the ability to protect the cylinder from pressure relief activation for nearly 60 minutes while other types designed specifically for thermal insulation can provide significant additional protection.

NTIS

Oxygen; Surface Temperature; Thermal Protection; Thermal Analysis

19990072346 Federal Aviation Administration, William J. Hughes Technical Center, Atlantic City, NJ USA

Video Landing Parameter Survey: Washington National Airport Final Report

Barnes, T.; DeFiore, T.; Micklos, R.; Jun. 1999; 50p; In English

Contract(s)/Grant(s): DTFA03-94-Z-0029

Report No.(s): PB99-156846; DOT/FAA/AR-97/106; No Copyright; Avail: CASI; A01, Microfiche; A03, Hardcopy

The Federal Aviation Administration William J. Hughes Technical Center is conducting a series of video landing parameter surveys at high-capacity commercial airports to acquire a better understanding of typical contact conditions for a wide variety of aircraft and airports as they relate to current aircraft design criteria and practices. This was the second in an ongoing series of parameter landing surveys and was conducted at Washington National Airport in June 1995. Four video cameras were temporarily installed along the east side of runway 36. Video images of 532 transport, (525 narrow-body jets and 7 commuter jets) were captured, analyzed, and the results presented herein. Landing parameters presented include sink rate; approach speed; touchdown pitch, roll, and yaw angles; off-center distance; and the touchdown distance from the runway threshold measured along the runway center line. Wind and weather conditions were also recorded and landing weights were available for most landings.

NTIS

Aircraft Landing; Design Analysis; Aircraft Design; Video Tapes

19990075050 Federal Aviation Administration, William J. Hughes Technical Center, Atlantic City, NJ USA

Longitudinal Acceleration Tests of Overhead Luggage Bins and Auxiliary Fuel Tank in a Transport Airplane Airframe Section *Final Report, Nov. 1997 - Jan. 1998*

McGuire, R.; Macy, T.; Jun. 1999; 356p; In English

Contract(s)/Grant(s): FAA DTF A03-95-R-00028

Report No.(s): PB99-165409; DOT/FAA/AR-99/4; No Copyright; Avail: CASI; A03, Microfiche; A16, Hardcopy

This report contains the description and test results of overhead stowage bin calibrations and longitudinal impact testing of a 10-foot transport airframe section conducted at the Transportation Research Center Inc. (TRC). The purpose of the tests was to measure the structural responses and interaction between the fuselage, overhead stowage bins, and auxiliary fuel tank under simulated, potentially survivable, crash conditions. A 10-foot section from a Boeing 737, Model 200 was used as the test section. The overhead stowage bin connection supports were instrumental with strain gages and calibrated. Two types of overhead storage bins were installed in the transport airframe and pulled in a longitudinal direction at various known loads to monitor and record the strain gage outputs. The transportation was longitudinally impact tested using TRC's 24-inch shock tester. The transport airframe section was configured with a 120-inch overhead stowage bin (Bin A) attached to the left/pilot side, a 60-inch overhead stowage bin (Bin B) attached to the right/copilot side, and a 500-gallon auxiliary fuel tank attached underneath the airframe's passenger floor section. The test articles were equipped with accelerometers, strain gages, and potentiometers totaling approximately 90 channels of data per simulated crash test.

NTIS

Fuel Tanks; Transport Aircraft; Airframes

19990076598 Army Safety Center, Fort Rucker, AL USA

Flightfax, Army Aviation Risk Management Information, Volume 27

Jul. 1999; 12p; In English

Report No.(s): AD-A365947; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Flightfax is published by the U.S. Army Safety Center, Fort Rucker, AL. Information is for accident prevention purposes only and is specifically prohibited for use for punitive purposes or matters of liability, litigation or competition.

DTIC

Safety; Prevention; Information Management; Risk; Armed Forces; Accident Prevention

19990076720 Federal Aviation Administration, Atlantic City, NJ USA

Longitudinal Acceleration Tests of Overhead Luggage Bins and Auxiliary Fuel Tank in a Transport Airplane Airframe Section *Final Report, Nov. 1997 - Jan. 1998*

McGuire, Robert, Federal Aviation Administration, USA; Macy, Tim, Transportation Research Center of Ohio, USA; Jun. 1999; 345p; In English

Contract(s)/Grant(s): DTFA03-95-R-00028

Report No.(s): AD-A365761; DOT/FAA/AR-99/4; No Copyright; Avail: CASI; A03, Microfiche; A15, Hardcopy

This report contains the description and test results of overhead stowage bin calibrations and longitudinal impact testing of a 10-foot transport airframe section conducted at the Transportation Research Center Inc. (TRC). The purpose of the tests was to measure the structural responses and interaction between the fuselage, overhead stowage bins, and auxiliary fuel tank under simulated, potentially survivable, crash conditions. A 10-foot section from a Boeing 737, Model 200 was used as the test section. The overhead stowage bin connection supports were instrumented with strain gages and calibrated. Two types of overhead storage

bins were installed in the transport airframe and pulled in a longitudinal direction at various known loads to monitor and record the strain gage outputs. The transport airframe was longitudinally impact tested using TRC's 24-inch shock tester. Peak accelerations and corresponding velocity changes of 6.1 g (23.2 ft/sec), 8.2 g (32.2 ft/sec), and 14.2 g (41.7 ft/sec) were recorded. The transport airframe section was configured with a 120-inch overhead stowage bin (Bin A) attached to the left/pilot side, a 60-inch overhead stowage bin (Bin B) attached to the right/copilot side, and a 500-gallon auxiliary fuel tank attached underneath the airframe's passenger floor section. The test articles were equipped with accelerometers, strain gages, and potentiometers totaling approximately 90 channels of data per simulated crash test.

DTIC

Airframes; Structural Analysis; Transport Aircraft; Fuselages; Fuel Tanks; Impact Tests; Crashes

19990078753 General Accounting Office, Washington, DC USA

Aviation Competition: Effects on Consumers From Domestic Airline Alliances Vary

Jan. 15, 1999; 74p; In English

Report No.(s): PB99-165243; GAO/RCED-99-37; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

Early in 1998, the six largest U.S. airlines, which account for nearly 70 percent of domestic airline traffic, announced their intentions to form three alliances, in which the partners---Northwest and Continental, Delta and United, and American and US Airways---would cooperate on some aspects of their business. These alliances vary from a limited marketing arrangement, such as reciprocal frequent flyer programs, to more complex agreements, such as those involving 'code-sharing' or one partner's ownership of an equity share in the other partner's business. The airlines say that these alliances will benefit consumers through expanded route networks and combined frequent flyer programs. Others, however, say that the alliances will decrease competition, ultimately reducing passengers' choices and increasing fares. Concerned over the potential anticompetitive effects of the alliances, the Department of Transportation is reviewing them, and the Department of Justice filed suit in October 1998 to prevent Northwest from acquiring voting control of Continental. Justice did not, however, request a temporary injunction precluding the transfer of voting control.

NTIS

Airline Operations; Airports; Commercial Aircraft

19990079848 Naval Surface Warfare Center, Indian Head, MD USA

Demonstration of Pintle Nozzle Controllable Propulsion for Fourth Generation Escape System Technology

Wheeler, Craig M., Naval Surface Warfare Center, USA; Niedzielski, Paul, Aerojet-General Corp., USA; Barnette, Bill, Aerojet-General Corp., USA; McDonald, A. Blair, Boeing Co., USA; 1998 JANNAF Propulsion Meeting; Jul. 1998; Volume 1, pp. 13-29; In English; See also 19990079846; No Copyright; Avail: Issuing Activity (CPIA, 10630 Little Patuxent Pkwy., Suite 202, Columbia, MD 21044-3200), Hardcopy, Microfiche

A joint US Air Force and US Navy technology demonstration program, spanning five years, evaluated and demonstrated advanced ejection seat technology using a pintle nozzle controllable solid propulsion system. The program objectives were demonstration of technologies for safe escape at adverse attitude and high-speed conditions using ejection seat flight control. Industry team prime contractor, Boeing (formerly McDonnell Douglas), and propulsion subcontractor Aerojet designed, built and tested the advanced technologies using an existing ACES II Air Force ejection seat as a demonstration test bed. The propulsion and control system used a four thruster pintle nozzle solid rocket motor which provided control of pitch, yaw, and roll moments to actively stabilize and control the ejection seat trajectory throughout an expanded ejection envelope. An onboard guidance and control unit used navigation inputs from an integrated inertial measurement unit and directed control of the thrust from the individual nozzles. Thrust at the pintle nozzles was regulated using thermal battery powered electromechanical actuators, which provided high response thrust control. Test results are presented from a series of Phase I static firing tests at Aerojet, and Phase II ejection tests at the Holloman AFB High Speed Test Track. The two-phase demonstration program successfully demonstrated the capability of the controllable propulsion technology, and identified lessons learned for integration into current and future ejection seat designs.

Author

Ejection Seats; Escape Systems; Evaluation; Control Equipment; Propulsion; Thrust Control

19990084061 National Inst. of Standards and Technology, Building and Fire Research Lab., Gaithersburg, MD USA

Survey of Fire Detection Technologies and System Evaluation/Certification Methodologies and Their Suitability for Aircraft Cargo Compartments

Cleary, T., National Inst. of Standards and Technology, USA; Grosshandler, W., National Inst. of Standards and Technology, USA; Jul. 1999; 56p; In English

Report No.(s): PB99-165169; NISTIR-6356; No Copyright; Avail: CASI; A01, Microfiche; A04, Hardcopy

As part of the National Aeronautics and Space Administration (NASA) initiated program on global civil aviation, NIST is assisting Federal Aviation Administration in its research to improve fire detection in aircraft cargo compartments. Aircraft cargo compartment detection certification methods have been reviewed. The Fire Emulator-Detector Evaluator (FE/DE) has been designed to evaluate fire detection technologies such as new sensors, multi-element detectors, and detectors that employ complex algorithms. The FE/DE is a flow tunnel that can reproduce velocity, temperature, smoke, and Combustion gas levels to which a detector might be exposed during a fire. A scientific literature survey and patent search have been conducted relating to existing and emerging fire detection technologies, and the potential use of new fire detection strategies in cargo compartment areas has been assessed. In the near term, improved detector signal processing and multi-sensor detectors based on combinations of smoke measurements, combustion gases and temperature are envisioned as significantly impacting detector system performance.

NTIS

Aircraft Compartments; Fires; Detection; Performance Prediction; Evaluation

19990087306 Massachusetts Inst. of Tech., Dept. of Aeronautics and Astronautics, Cambridge, MA USA

Helmet-Mounted Display Symbology for Ground Collision Avoidance in Fighter Aircraft

Taylor, Jonathan B.; Jul. 28, 1999; 130p; In English

Report No.(s): AD-A366235; No Copyright; Avail: CASI; A07, Hardcopy; A02, Microfiche

A two-part experimental simulation study was performed to examine ways of improving Ground Collision Avoidance Systems (GCAS) for fighter aircraft through the use of Helmet-Mounted Display (HMD) symbology. Modality and information presentation issues were addressed through the design and testing of five display formats. An audio alert with no visual symbology was used as a baseline. The addition of visual alert symbology was tested using a head-fixed iconic alerting cue. Formats for additional recovery information were tested using an aircraft-fixed guidance cue, a head-fixed guidance cue, and a head-fixed guidance cue with a pitch ladder. Subjects were given audio and visual side tasks and then responded to GCAS alerts. Recovery performance and subjective ratings of the displays were recorded. Lower reaction times were observed when a head-fixed visual alert was given in addition to the standard audio alert. No significant differences were seen in subject recovery performance, measured by altitude loss and response times. However, subject head motion varied significantly with display type. Subjects tended to fixate on guidance and state symbology when it was provided. This led to cases where pilots performed entire recoveries with their heads off-boresight when using head-fixed guidance symbology. Subjects varied in their preference of symbology, but head-fixed guidance and state information was preferred over the other display categories using the Analytical Hierarchy Process.

DTIC

Helmet Mounted Displays; Fighter Aircraft; Collision Avoidance; Warning Systems

19990087330 Federal Aviation Administration, Washington, DC USA

Notices to Airmen Domestic/International, June 17, 1999

Jun. 17, 1999; 270p; In English

Report No.(s): PB99-165391; No Copyright; Avail: CASI; A12, Hardcopy; A03, Microfiche

The paper discussed the following topics: Airway Notams; Airports, Facilities, and Procedural Notams; General FDC Notams; Part 95 Revisions to Minimum En Route IFR Altitudes and Changeover Points; International Notices to Airmen; and Graphic Notices.

NTIS

Air Navigation; Runways; Airports; Flight Paths; Air Traffic Control; Navigation Aids

04

AIRCRAFT COMMUNICATIONS AND NAVIGATION

Includes digital and voice communication with aircraft; air navigation systems (satellite and ground based); and air traffic control.

19990078747 Federal Aviation Administration, Research and Special Programs, Cambridge, MA USA

Guidelines for the Use of Color in ATC Displays *Final Report*

Cardosi, K., Federal Aviation Administration, USA; Hannon, D., Federal Aviation Administration, USA; Jun. 1999; 70p; In English

Contract(s)/Grant(s): FA9L1/A9112

Report No.(s): PB99-166571; DOT/VNTSC/FAA-98-5; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

This paper offers general guidelines on how color should, and should not, be used, but does not define a specific color-coding scheme. These guidelines are based on what is known about human vision, display capabilities, the knowledge gained from the lessons learned from the uses of color in the cockpit and ATC environments, and human factors 'best practices'. The report also discusses a series of experiments that examined color production capabilities within and across five Sony DDM-2801C monitors and selected and validated an 'ideal' color set for this monitor.

NTIS

Air Traffic Control; Cockpits; Color; Human Factors Engineering; Color Vision

19990079373 NASA Marshall Space Flight Center, Huntsville, AL USA

1999 Guidance, Navigation, and Control Highlights

Polites, Michael E., NASA Marshall Space Flight Center, USA; 1999; In English; Copyright; Avail: Issuing Activity; Abstract Only, Hardcopy, Microfiche

This article summarizes the highlights of recent events and developments in guidance, navigation, and control in space, aircraft, and weapons. This article is about 1,200 words long. Information for the article was collected from other NASA Centers, DoD, and industry. All information was previously cleared by the originating organizations. Information for the article was also gathered from Aviation Week and Space Technology, Space News, and similar sources.

Author

Guidance (Motion); Navigation; Spacecraft Control

19990079381 Federal Aviation Administration, William J. Hughes Technical Center, Atlantic City, NJ USA

Trajectory Prediction Accuracy Report: User Request Evaluation Tool (URET)/Center-TRACON Automation System (CTAS)

Paglione, Mike M.; Ryan, Hollis F.; Oaks, Robert D.; Summerill, J. S.; Cale, Mary L.; May 1999; 547p; In English Report No.(s): AD-A365862; DOT/FAA/CT-TN99/10; No Copyright; Avail: CASI; A23, Hardcopy; A04, Microfiche

This report presents the results of an independent analysis of the accuracy of the trajectory modelers implemented in the User Request Evaluation Tool (URET) and Center-TRACON Automation System (CTAS) prototypes. These results are based on the completion of the first phase of a planned two phased effort. As originally envisioned, efforts during Phase I would develop a generic methodology to measure the trajectory prediction accuracy of any decision support tool (DST), which would be validated by applying it to CTAS and URET based on their currently adapted sites. In Phase II, the methodology would be applied to URET and CTAS adapted to a common site and supplied with the same scenario. As such, the results from Phase I would have provided a common set of results based on the same site and scenario, allowing a comparison of the two trajectory modelers to be made, in support of research into the performance requirements for a common en route trajectory model. Due to funding cuts, this task was curtailed to the completion of Phase I. The results from this phase do provide the FAA with an independent set of scenario-based trajectory accuracy statistics for each DST, but they cannot be used to compare the two DSTs due to the confounding site-specific factors. A methodology was developed and CTAS and URET were measured based on one scenario each from their currently adapted sites (Fort Worth and Indianapolis, respectively). The Phase I study measured the spatial error between trajectory predictions versus the Host Computer System (HCS) track position reports, which were assumed to be the ground truth location of the aircraft. The spatial error consisted of horizontal and vertical errors. The horizontal error was further partitioned into two geometric components, lateral and longitudinal errors, representing the cross track and along track prediction errors. The focus of the analysis was on the overall trajectory accuracy of each DST, not on individual errors.

DTIC

Automatic Control; Flight Paths; Air Traffic; Flight Plans

19990079745 National Aerospace Lab., Tokyo Japan

Development of Kinematic GPS Software, KINGS and Flight Test Evaluation

Tsujii, T.; Murata, M.; Harigae, M.; Ono, T.; Inagaki, T.; Oct. 1998; 62p; In Japanese; Portions of this document are not fully legible Report No.(s): PB99-164873; NAL/TR-1357T; Copyright; Avail: National Technical Information Service (NTIS), Hardcopy

Precise positioning using GPS carrier phase measurement can be applied to the precise positioning of a moving platform if an ambiguity contained in the GPS carrier phase measurement is resolved during the motion. The technique to resolve the ambiguity on the way/fly, which is called the OTF (on-the-Fly), has been investigated by many authors. In this paper, a new OTF algorithm is proposed and its feasibility for several kinds of applications is demonstrated. The differential GPS positioning using carrier phase measurements is called Kinematic GPS (KGPS). We have developed our own Kinematic GPS Software, KINGS, in which the OTF is the most significant algorithm, and have evaluated its performance by conducting a lot of flight experiments using a research aircraft of the National Aerospace Laboratory (NAL). As a result, the correct ambiguity was resolved nearly

instantaneously with more than 98% probability when the distance between the aircraft receiver and the ground reference receiver was less than 20 km, and five or more satellites were observed. Once the ambiguity was resolved, the aircraft position was determined within 10 cm.

NTIS

Kinematics; Global Positioning System; Computer Programming; Flight Tests; Software Engineering

19990080909 NASA Wallops Flight Facility, Wallops Island, VA USA

Tracking the Relative Motion of Four Space Payloads Launched from a Sub-Orbital NASA Rocket

Bull, Barton, NASA Wallops Flight Facility, USA; Martell, Hugh, Waypoint Consulting, Inc., USA; 1999; 1p; In English; 4th, 18-21 Oct. 1999, Netherlands; Sponsored by European Space Agency; No Copyright; Avail: Issuing Activity, Hardcopy; Abstract Only

One problem, which is comparatively new in the field of GPS (Global Positioning System) applications, is the determination of the relative trajectories of space vehicles. Applications include the docking of spacecraft, collision avoidance in the area of space stations, and trajectory reconstruction of multiple payloads. The required precision in any of these applications will vary, according to the requirements of the task and abilities of GPS to cope with the environment and the dynamics. This paper describes the post-mission reconstruction of the relative trajectories of four GPS receivers attached to four payloads jettisoned from a Black Brant XII rocket. This vehicle was launched by the National Aeronautics and Space Administration (NASA) in January 1999 from the Poker Flats Research Range near Fairbanks, Alaska. The Black Brant XII is a sub-orbital rocket designed to carry payloads of 100 to 500 kg into the upper atmosphere. Flight time is generally in the order of 10 - 20 minutes.

Derived from text

Global Positioning System; Receivers; Spacecraft Tracking; Launch Vehicles; Rocket Vehicles

19990080923 NASA Goddard Space Flight Center, Greenbelt, MD USA

Implementation of Autonomous GPS Guidance and Control for Spacecraft Formation Flying

Xing, Guang Q., Space Products and Applications, USA; Parvez, Shabbir A., Space Products and Applications, USA; Foltz, David, NASA Goddard Space Flight Center, USA; 1999; 6p; In English; American Control, 2-4 Jun. 1999, San Diego, CA, USA Contract(s)/Grant(s): NAS5-98092; No Copyright; Avail: Issuing Activity, Hardcopy

This paper presents the general relative orbit dynamics equations and GPS (Global Positioning System) orbit observational equations that have been developed for on-board control of spacecraft flying in formation. The approach to the implementation of the autonomous control for orbit acquisition and maintenance of spacecraft formation using GPS code pseudoranges are presented. As a practical application of the models and method provided in this paper, the orbit control of the Earth-Orbiter 1(EO-1) / LANDSAT 7 system has been designed, using the discrete-time linear optimal output feedback control. For the actuator of the on/off type reaction jets, the implementation problem of the pulse-amplitude modulation is also studied. Simulation results of autonomous orbit control and maintenance, for 3-dimensional initial orbit error, using optimal output feedback control are shown. These simulation results certified the feasibility of the implementation of the autonomous maintenance control for EO-1/LANDSAT 7 formation flying by means of the discrete-time linear optimal output feedback control.

Author

Feedback Control; Global Positioning System; Spacecraft Control; Spacecraft Guidance; Time Optimal Control; Space Navigation

05

AIRCRAFT DESIGN, TESTING AND PERFORMANCE

Includes aircraft simulation technology.

19990070424 Naval Aviation Systems Team, Patuxent River, MD USA

Integrated Mechanical Diagnostics IIUMS: Overview and Status

Muldoon, Rick, Naval Aviation Systems Team, USA; Gill, John, Goodrich (B. F.) Aerospace, USA; Workshop on Helicopter Health and Usage Monitoring Systems; March 1999, Pt. 2, pp. 19-34; In English; See also 19990070423; Copyright; Avail: Issuing Activity (DSTO Aeronautical and Maritime Research Lab., PO Box 4331, Melbourne, Victoria 3001, Australia), Hardcopy, Microfiche

IMD HUMS is a commercial Operations and Support Saving Initiative (COSSI) to improve helicopter operational readiness and flight safety while slashing maintenance-related costs.

Derived from text

Helicopters; Maintainability; Flight Safety

19990070425 Royal Air Force, Aerospace Maintenance Development and Support, Huntingdon, UK

Introduction of HUMS into the RAF

Horsley, Dave, Royal Air Force, UK; Workshop on Helicopter Health and Usage Monitoring Systems; March 1999, Pt. 2, pp. 35-50; In English; See also 19990070423; Copyright; Avail: Issuing Activity (DSTO Aeronautical and Maritime Research Lab., PO Box 4331, Melbourne, Victoria 3001, Australia), Hardcopy, Microfiche

Contents include the following: Logistic support services, expectations, projects, and industrial strategy.

CASI

Support Systems; Logistics

19990070426 Eurocopter France, Marignane, France

Eurocopter HUMS: The Helicopter Manufacturer Commitments

Lubrano, Phillippe, Eurocopter France, France; Feraud, Pierre, Eurocopter France, France; Workshop on Helicopter Health and Usage Monitoring Systems; March 1999, Pt. 2, pp. 51-61; In English; See also 19990070423; Copyright; Avail: Issuing Activity (DSTO Aeronautical and Maritime Research Lab., PO Box 4331, Melbourne, Victoria 3001, Australia), Hardcopy, Microfiche

Contents include the following: safety and confidence, Health and Usage Monitoring System (HUMS) design, HUMS module configuration, safety and cost benefits.

CASI

Safety; Design Analysis; Costs; Health

19990070427 Defence Science and Technology Organisation, Airframes and Engines Div., Melbourne, Australia

Machine Dynamics

Rebbechi, Brian, Defence Science and Technology Organisation, Australia; Wong, Albert, Defence Science and Technology Organisation, Australia; Workshop on Helicopter Health and Usage Monitoring Systems; March 1999, Pt. 2, pp. 63-74; In English; See also 19990070423; Copyright; Avail: Issuing Activity (DSTO Aeronautical and Maritime Research Lab., PO Box 4331, Melbourne, Victoria 3001, Australia), Hardcopy, Microfiche

Contents include the following: Advanced transmission diagnostics, propulsion system vibration analysis, vibration monitoring of Navy helicopters, active vibration control of propulsion systems,

CASI

Systems Analysis; Helicopters; Active Control

19990070430 Analysis, Management and Systems (Pty) Ltd., South Africa

Health and Usage Monitoring System for the Rooivalk Combat Support Helicopter

Botes, C. J., Analysis, Management and Systems (Pty) Ltd., South Africa; Workshop on Helicopter Health and Usage Monitoring Systems; March 1999, Pt. 2, pp. 103-114; In English; See also 19990070423; Copyright; Avail: Issuing Activity (DSTO Aeronautical and Maritime Research Lab., PO Box 4331, Melbourne, Victoria 3001, Australia), Hardcopy, Microfiche

The Health and Usage Monitoring System (HUMS) developed for the Denel Aviation Rooivalk CSH forms an integral part of the System Status Monitoring (SSM) capability of the aircraft. It provides an on-board capability to monitor and report basic aircraft health, usage on critical components, status, performance and limits exceedances to both the air and ground crews. The HUMS comprises of the following elements: a) Two Health Monitoring Units (HMUs) which include the Master Warning electronics; b) Vibration Monitoring Unit (VMU); c) Refuel/Defuel Unit (RDU); d) Crash Recorder Unit (CRU) (optional); e) Mission Planning and Ground Support Station; f) Set-up and Diagnostics Station. This is an excellent example of a fully integrated HUMS with all the associated benefits of minimising the number of Line Replaceable Units (LRUs) on-board the aircraft.

Author

Health; Monitors; Helicopters; Combat

19990070431 Defence Science and Technology Organisation, Airframes and Engines Div., Melbourne, Australia

Lubrication Oil Debris Monitoring Program at AMRL

Parmington, Ben, Defence Science and Technology Organisation, Australia; Workshop on Helicopter Health and Usage Monitoring Systems; March 1999, Pt. 2, pp. 115-121; In English; See also 19990070423; Copyright; Avail: Issuing Activity

(DSTO Aeronautical and Maritime Research Lab., PO Box 4331, Melbourne, Victoria 3001, Australia), Hardcopy, Microfiche
Enhance AMRL's understanding of the operation and performance of existing and new generation oil debris monitors, in order to better position AMRL to provide advance to the Australian Defence Force on the performance of monitors used on existing aircraft and of new generation monitors that are becoming available.

Derived from text

Lubrication; Oils; Debris; Monitors

19990071045 Nangia Aero Research Associates, Bristol, UK

Modelling of 3-D Aircraft Inlets at "Zero" Speed (and Low Speeds With Crosswind) and Flow Separation Prediction

Nangia, R. K., Nangia Aero Research Associates, UK; Palmer, M. E., Nangia Aero Research Associates, UK; Hodges, J., Defence Evaluation Research Agency, UK; Verification of Design Methods by Test and Analysis: Proceedings; 1998, pp. 2.1 - 2.14; In English; See also 19990071044; Copyright; Avail: Issuing Activity (The Royal Aeronautical Society, 4 Hamilton Place, London, W1V 0BQ, UK), Hardcopy, Microfiche

The location and design of an engine intake depends upon the operational and installation needs. These are different for combat aircraft and civil / transport aircraft. The shapes of the inlets can therefore differ widely as may the contraction ratios. An aspect that needs to be understood and "certified" for each intake is its behaviour when onset speeds are near zero or small. Such a situation can occur in maneuvers or on the runway as an aircraft (military or civil) prepares for take-off and begins to roll. Full engine power with brakes on can lead to an engine-face Mach M(Sub E) increase as well as very high velocities at the inlet lip (or in the throat, depending on the inlet contraction ratio CR). Subject to intake lip geometry (sharper the worse), this can cause onset of internal flow separations and unsteady effects which are deleterious to the propulsion system and may lead to flame-out or long term fatigue damage. Further, a small cross-wind may lead to very large flow bias and hence initiate internal flow separations. Close proximity to the ground (or indeed, near another surface or store), leads to a "one-sided" flow distortion effect. This paper describes the methodology used, verification with some test data and then applies techniques to several different types of intake.

Author

Three Dimensional Models; Engine Inlets; Design Analysis; Separated Flow; Transport Aircraft

19990071046 Institute of Theoretical and Applied Mechanics, Novosibirsk, Russia

Numerical and Experimental Studies of 3D Hypersonic Inlet

Goldfeld, M. A., Institute of Theoretical and Applied Mechanics, Russia; Nestoulia, R. V., Institute of Theoretical and Applied Mechanics, Russia; Verification of Design Methods by Test and Analysis: Proceedings; 1998, pp. 3.1 - 3.12; In English; See also 19990071044; Copyright; Avail: Issuing Activity (The Royal Aeronautical Society, 4 Hamilton Place, London, W1V 0BQ, UK), Hardcopy, Microfiche

The results of numerical and experimental studies of a new configuration of 3D hypersonic inlet with the minimum throat area, which was called a convergent inlet, are presented in this paper. It is shown that the use of this inlet configuration allows one to reduce the drag and thermal protection of surfaces of a hypersonic engine within the entire range of flight velocities. This is achieved by decreasing the inclination of external compression surfaces and reducing the area of the inlet duct and combustor walls. The inlet configuration was constructed on the basis of gas dynamic design methods using the flows of lower dimension. The calculations were performed within the framework of inviscid gas model by the method of finite volumes. The flow and inlet characteristics, taking account of viscosity, were also calculated using the boundary layer equations. The numerical algorithm was verified by calculated and experimental data for a finite-width wedge and external compression surface of a convergent inlet. The experimental studies were performed within the Mach number range from 2 to 10.7 and Reynolds number based on the model inlet height of $Re=1-5 \cdot 10^{(exp 6)}$. The results included the flow parameters on the external compression surface and in the inlet duct, the Mach number in the throat, the air flow rate, the total pressure recovery coefficient, and the inlet drag. Besides, the boundary layer characteristics on compression surfaces were determined, including the skin friction coefficients. The numerical and experimental results are in good agreement. These results are also compared with the data for traditional 2D inlets.

Author

Numerical Analysis; Experimentation; Three Dimensional Models; Hypersonic Inlets; Data Acquisition; Air Flow; Flow Characteristics; Intake Systems; Computerized Simulation

19990071047 Northern Research and Engineering Corp., Woburn, MA USA

Design Verification of Turbomachinery Components by 3-D Flow Analysis

Oreper, Gregory, Northern Research and Engineering Corp., USA; Verification of Design Methods by Test and Analysis: Proceedings; 1998, pp. 5.1 - 5.13; In English; See also 19990071044; Copyright; Avail: Issuing Activity (The Royal Aeronautical

Society, 4 Hamilton Place, London, W1V 0BQ, UK), Hardcopy, Microfiche

A system to perform turbomachinery flow analysis for design verification has been developed. The system has a pre-processor, a grid generator, an automatic boundary conditions generator, a flow analysis module, and a post-processor that allows designers to quickly evaluate properties of the design. The pre-processor also includes an initial condition generator. All modules are accessible through a graphical user interface. The flow analysis can be viscous or inviscid, steady or unsteady. The system can be used to verify designs of single components, stages, multiple stages, axial centrifugal, or mixed flow paths, compressors, turbines, or ducts. The numerical method used in the flow analysis module is based on the fully implicit algorithm developed by Beam and Warming. The algorithm was approximately factored by Pulliam and Steger and diagonalized by Pulliam and Chaussee. To model turbulence, several algebraic turbulence models, based on the Baldwin and Lomax formulation, were implemented. For complicated flows, a two-equation model of D. Wilcox is available. The computational system has a set of standard test cases to validate flow analysis result. This set of standard test cases covers major types of turbomachinery components and stages. In this paper, the system capabilities in the turbomachinery design verification process are shown through examples of calculations made for centrifugal and axial turbomachinery components. turbomachinery component.

Author

Design Analysis; Proving; Turbomachinery; Flow Characteristics; Three Dimensional Flow; Mathematical Models; Baldwin-Lomax Turbulence Model; Engine Design; Computational Fluid Dynamics

19990071185 NASA Langley Research Center, Hampton, VA USA

Experimental Investigation of Convolutional Contouring for Aircraft Afterbody Drag Reduction

Deere, Karen A., NASA Langley Research Center, USA; [1999]; In English; 35th Joint Propulsion, 20-24 Jun. 1999, Los Angeles, CA, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA

Report No.(s): AIAA Paper 99-2670; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

An experimental investigation was performed in the NASA Langley 16-Foot Transonic Tunnel to determine the aerodynamic effects of external convolutions, placed on the boattail of a nonaxisymmetric nozzle for drag reduction. Boattail angles of 15 and 22 deg were tested with convolutions placed at a forward location upstream of the boattail curvature, at a mid location along the curvature and at a full location that spanned the entire boattail flap. Each of the baseline nozzle afterbodies (no convolutions) had a parabolic, converging contour with a parabolically decreasing corner radius. Data were obtained at several Mach numbers from static conditions to 1.2 for a range of nozzle pressure ratios and angles of attack. An oil paint flow visualization technique was used to qualitatively assess the effect of the convolutions. Results indicate that afterbody drag reduction by convolutional contouring is convolution location, Mach number, boattail angle, and NPR dependent. The forward convolution location was the most effective contouring geometry for drag reduction on the 22 deg afterbody, but was only effective for M is less than 0.95. At M = 0.8, drag was reduced 20 and 36 percent at NPRs of 5.4 and 7, respectively, but drag was increased 10 percent for M = 0.95 at NPR = 7. Convolutional contouring along the 15 deg boattail angle afterbody was not effective at reducing drag because the flow was minimally separated from the baseline afterbody, unlike the massive separation along the 22 deg boattail angle baseline afterbody.

Author

Boattails; Afterbodies; Wind Tunnel Tests; Drag Reduction; Pressure Ratio; Nozzle Geometry; Nozzle Design; Exhaust Nozzles; Pressure Drag; Aerodynamic Drag; Transonic Speed; Mach Number

19990071186 NASA Ames Research Center, Moffett Field, CA USA

Overview of the Testing of a Small-Scale Proprotor

Young, Larry A., NASA Ames Research Center, USA; Yamauchi, Gloria K., NASA Ames Research Center, USA; Booth, Earl R., Jr., NASA Ames Research Center, USA; Botha, Gavin, NASA Ames Research Center, USA; Dawson, Seth, Boeing Co., USA; 1999; In English; 55th, 25-27 May 1999, Montreal, Quebec, Canada; Sponsored by American Helicopter Society, Inc., USA; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

This paper presents an overview of results from the wind tunnel test of a 1/4-scale V-22 proprotor in the Duits-Nederlandse Windtunnel (DNW) in The Netherlands. The small-scale proprotor was tested on the isolated rotor configuration of the Tilt Rotor Aeroacoustic Model (TRAM). The test was conducted by a joint team from NASA Ames, NASA Langley, U.S. Army Aeroflightdynamics Directorate, and The Boeing Company. The objective of the test was to acquire a benchmark database for validating aeroacoustic analyses. Representative examples of airloads, acoustics, structural loads, and performance data are provided and discussed.

Author

V-22 Aircraft; Aeroacoustics; Wind Tunnel Tests; Rotary Wings; Aircraft Noise; Propeller Efficiency; Aerodynamic Loads

19990071396 NASA Dryden Flight Research Center, Edwards, CA USA

Selected Performance Measurements of the F-15 ACTIVE Axisymmetric Thrust-Vectoring Nozzle

Orme, John S., NASA Dryden Flight Research Center, USA; Sims, Robert L., NASA Dryden Flight Research Center, USA; September 1999; 12p; In English; 14th, 5-10 Sep. 1999, Florence, Italy; Sponsored by International Society for Airbreathing Engines

Contract(s)/Grant(s): RTOP 529-20-24

Report No.(s): H-2339; ISABE Paper 1S-166; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Flight tests recently completed at the NASA Dryden Flight Research Center evaluated performance of a hydromechanically vectored axisymmetric nozzle onboard the F-15 ACTIVE. A flight-test technique whereby strain gages installed onto engine mounts provided for the direct measurement of thrust and vector forces has proven to be extremely valuable. Flow turning and thrust efficiency, as well as nozzle static pressure distributions were measured and analyzed. This report presents results from testing at an altitude of 30,000 ft and a speed of Mach 0.9. Flow turning and thrust efficiency were found to be significantly different than predicted, and moreover, varied substantially with power setting and pitch vector angle. Results of an in-flight comparison of the direct thrust measurement technique and an engine simulation fell within the expected uncertainty bands. Overall nozzle performance at this flight condition demonstrated the F100-PW-229 thrust-vectoring nozzles to be highly capable and efficient.

Author

F-15 Aircraft; Thrust Vector Control; Flight Tests; Thrust Measurement; Nozzle Geometry; Subsonic Speed; Nozzle Flow; Performance Tests

19990071577 SRI International Corp., Menlo Park, CA USA

Characterization of Early Stages of Corrosion Fatigue in Aircraft Skin, Phase 2, Interpretation of Corrosion-Fatigue Fracture Surfaces in Alclad 2024-T3 Aluminum Alloy Sheet, Oct. 1995 - Sep. 1998

Schmidt, C. G.; Kobayashi, T.; Shockey, D. A.; May 1999; 75p; In English

Contract(s)/Grant(s): 95-G-065

Report No.(s): AD-A365106; DOT/FAA/AR-99/34; No Copyright; Avail: CASI; A01, Microfiche; A04, Hardcopy

New methods were developed and applied to extract and interpret information from the fracture surfaces of corrosion-fatigue specimens of clad and bare 2024-T3 aluminum sheet. We developed two fracture surface topography analysis methods that characterize the effects of environment and a fracture surface analysis and finite element modeling approach to detect and quantify overloads that occurred during fatigue crack propagation. We used these methods to perform a detailed analysis of the fracture surface topography produced in the early stages of corrosion fatigue, and developed an understanding of the effect of environment on the crack nucleation mechanism based on fracture surface features. In addition, cyclic load experiments were conducted on bare and clad 2024-T3 sheet under vacuum and in air, salt water, and arsenated salt water environments to assess the effects of environment, stress, and material condition on nucleation and early propagation kinetics of corrosion-fatigue cracks. For bare 2024-T3 sheet, substantial reductions in fatigue life were observed when the environment produced elongated pits associated with constituent particle corrosion. For clad 2024-T3 sheet, reductions in fatigue life were observed in environments that did not produce pitting (e.g., laboratory air and salt water). A likely mechanism for enhanced crack nucleation in 2024-T3 sheet with pure aluminum clad is the weakening effect of hydrogen on pure aluminum and the concomitant enhancement of cracking kinetics. The analytical methods developed and the analyses performed bear directly on the understanding of corrosion-fatigue in commercial aircraft through the relevancy of the materials, loading conditions, and test environments.

DTIC

Fatigue (Materials); Fracturing; Aluminum; Cladding; Aluminum Alloys; Metal Sheets; Skin (Structural Member); Stress Corrosion

19990072347 Northrop Grumman Corp., Aircraft Div., Dallas, TX USA

Probabilistic Design Methodology for Composite Aircraft Structures Final Report, Sep. 1995 - Oct. 1997

Long, M. W.; Narciso, J. D.; Jun. 1999; 150p; In English

Contract(s)/Grant(s): FAA 95G-0036

Report No.(s): PB99-156838; DOR/FAA/AR-99/2; No Copyright; Avail: CASI; A02, Microfiche; A07, Hardcopy

Probabilistic structural analysis methods provide a means to quantify the inherent risk of a design and assess the sensitivities of design variables. This report is intended to introduce the subject of probability analysis to engineers in the aerospace industry as well as act as a reference to guide those applying this technology. The current (deterministic) structural analysis approach is described, and its shortcomings are pointed out. The evolution of probabilistic analysis is presented, and the basic theory is discussed and explained via examples. Aerospace industry method development is described in detail, along with associated

aerospace applications. An in-depth explanation of one industry method (Northrup Grumman) is given, along with an example run of their computer program. The report concludes with a consensus of potential benefits as well as potential issues of concern that must be addressed by those using these analysis methods.

NTIS

Design Analysis; Composite Materials; Composite Structures; Aerospace Engineering; Structural Analysis; Aircraft Design; Aircraft Structures; Structural Design Criteria

19990073341 International Centre for Aviation and the Environment, Montreal, Quebec Canada

Survey of Nonglycol and Reduced Glycol Aircraft Deicing Methods *Final Report*

Cornish, Jeremy; Eyre, Frank; Apr. 1999; 67p; In English

Report No.(s): AD-A365050; DOT/FAA/AR-99/18; No Copyright; Avail: CASI; A01, Microfiche; A04, Hardcopy

This survey of no glycol and low-glycol aircraft deicing practices, methods, and procedures used by the world's airlines, including cargo carriers, was conducted under contract to the Federal Aviation Administration (FAA) William J. Hughes Technical Center. A representative sample of 80 of the world's airlines and airports with operations under winter ground icing conditions were surveyed by mail for their experience with no glycol or reduced-glycol deicing methods. Twenty-five responded The written survey was supported by face-to-face interviews and telephone interviews. The results are presented in descriptive format for each of the procedures identified along with sample illustrations where appropriate. A summary is given of the principle characteristics for each procedure. Although the focus of the survey was the procedures in use, a number of technologies under development and which have been field tested have been included, such as truck-mounted blown air systems, mobile infrared heaters, and preheating of fuel prior to refueling. Major reductions in glycol use can be achieved through the use of simple mechanical aids such as scrapers or brushes to remove snow accumulation prior to conventional deicing.

DTIC

Deicing; Glycols; Surveys; Deicers; Ice Prevention

19990075952 Department of the Navy, Washington, DC USA

Pencil Drain Fixture for Aircraft Defueling

Hannick, Sidney L., Inventor; Mar. 09, 1999; 5p; In English

Patent Info.: Filed 15 Sep. 97.; US-Patent-Appl-SN-929,977; US-Patent-5,878,799

Report No.(s): AD-D019394; No Copyright; Avail: US Patent and Trademark Office, Microfiche

A pencil drain fuel fixture for defueling aircraft pencil drains is provided. The pencil drain fixture has an extendable strut with a non-slip rubber base. The strut is set up on the tarmac under an aircraft pencil drain and extended to engage the drain. The upper end of the strut contains a funnel and pencil drain release rod mechanism which opens the pencil drain and by funnel and drain tube directs the fuel to a catch basin.

DTIC

Fuels; Drainage; Funnels; Aerospace Vehicles

19990075982 Department of the Navy, Washington, DC USA

Oscillating Flap Lift Enhancement Device

Greenhalgh, Samuel, Inventor; Mar. 23, 1999; 9p; In English

Patent Info.: Filed 30 Aug. 95.; US-Patent-Appl-SN-528,622

Report No.(s): AD-D019368; PATENTED,5,884-872; No Copyright; Avail: US Patent and Trademark Office, Microfiche

A lift enhancing device for a solid wing is disclosed wherein a where a motor driven, flap dynamically oscillating flap mechanism produces an increase in the lifting capabilities of the wing.

DTIC

Wings; Aircraft Parts

19990076674 Department of the Navy, Washington, DC USA

Neural Network Based Method for Estimating Helicopter Low Airspeed

Schaefer, Carl G., Jr., Inventor; McCool, Kelly M., Inventor; Haas, David J., Inventor; Mar. 30, 1999; 16p; In English

Patent Info.: Filed 22 OCT. 97.; US-Patent-Appl-SN-955,970; US-Patent-5,890,101

Report No.(s): AD-D019419; No Copyright; Avail: US Patent and Trademark Office, Microfiche

The invention is directed to a system, utilizing a neural network, for estimating helicopter airspeed in the low airspeed flight range of below about 50 knots using only fixed system parameters as inputs to the neural network. The method includes the steps of: (a) defining input parameters derivable from variable state parameters generated during flight of the helicopter and measurable

in a nonrotating reference frame associated with the helicopter; (b) determining the input parameters and a corresponding helicopter airspeed at a plurality of light conditions representing a predetermined low airspeed flight domain of the helicopter; (c) establishing a learned relationship between the determined input parameters and the corresponding helicopter airspeed wherein the relationship is represented by at least one nonlinear equation; (d) storing the at least one nonlinear equation in a memory onboard the helicopter; (e) measuring real time values of the variable state parameters during low airspeed flight of the helicopter; (f) calculating real time values of the input parameters; (g) storing the real time values of the input parameters in the memory; (h) processing the real time values of the input parameters in accordance with the at least one nonlinear equation to determine real time airspeed; and (i) displaying the real time airspeed.

DTIC

Neural Nets; Procedures; Estimating; Helicopters; Airspeed; Speed Indicators

19990076726 Northrop Grumman Corp., Commercial Aircraft Div., Dallas, TX USA

Probabilistic Design Methodology for Composite Aircraft Structures *Final Report, Sep. 1995 - Oct. 1997*

Long, M. W., Northrop Grumman Corp., USA; Narciso, J. D., Northrop Grumman Corp., USA; Jun. 1999; 138p; In English
Report No.(s): AD-A365683; 2-51410/7R-001; DOT/FAA/AR-99/2; No Copyright; Avail: CASI; A07, Hardcopy; A02, Microfiche

Probabilistic structural analysis methods provide a means to quantify the inherent risk of a design and assess the sensitivities of design variables. This report is intended to introduce the subject of probabilistic analysis to engineers in the aerospace industry as well as act as a reference to guide those applying this technology. The current (deterministic) structural analysis approach is described, and its shortcomings are pointed out. The evolution of probabilistic analysis is presented, and the basic theory is discussed and explained via examples. Aerospace industry method development is described in detail, along with associated aerospace applications. An in-depth explanation of one industry method (Northrop Grumman) is given, along with an example run of their computer program. The report concludes with a consensus of potential benefits as well as potential issues of concern that must be addressed by those using these analysis methods.

DTIC

Structural Analysis; Aircraft Structures; Composite Structures; Composite Materials; Design Analysis; Probability Theory

19990076729 Defence Science and Technology Organisation, Canberra, Australia

A Review of Australian and New Zealand Investigations on Aeronautical Fatigue During the Period April 1997 to March 1999, *Apr. 1997 - Mar. 1999*

Martin, Colin, Defence Science and Technology Organisation, Australia; Jun. 1999; 67p; In English

Report No.(s): AD-A365659; DSTO-TN-0206; DODA-AR-010-988; No Copyright; Avail: CASI; A01, Microfiche; A04, Hardcopy

This document has been prepared for presentation to the 26th Conference of the International Committee on Aeronautical Fatigue scheduled to be held in Bellevue, Washington USA on 12th and 13th July 1999. The review covers fatigue-related research programs as-well as fatigue investigations on specific military and civil aircraft in research laboratories, universities, and aerospace companies in Australia and New Zealand during the period April 1997 to March 1999.

DTIC

Fatigue (Materials); Conferences; Aircraft Maintenance; Aerospace Industry

19990078540 General Accounting Office, Program Evaluation and Methodology Div., Washington, DC USA

Air Force Logistics: C-17 Support Plan Does Not Adequately Address Key Issues. Report to Congressional Requesters

Jul. 1999; 34p; In English

Report No.(s): AD-A365566; GAO/NSIAD-99-147; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

For many years the Air Force has relied on contractors to provide logistics support for commercial derivative systems such as the KC-10 aircraft as well as for some high-cost, highly classified systems produced in small quantities, such as the U2. In recent years the Department of Defense (DOD) and the services have initiated actions to expand contractor logistics support to other military systems that were not derived from similar commercial systems. The Air Force has designated the C-17 as 1 of the 10 Air Force systems that will be used as a pilot to implement a DOD initiative that will emphasize contracting with the private sector for support services as a part of its logistics reengineering efforts. This designation of the C-17 as a pilot project is consistent with defense reform initiatives, which called for a strategic shift toward increased reliance on the private sector to meet support needs.

DTIC

Logistics; Congressional Reports; Defense Program

19990078609 Army Research Lab., Aberdeen Proving Ground, MD USA

Analytical Investigation into the Helicopter Vibration Resulting from Main Rotor Blade (MRB) Ballistic Damage *Final Report*

Kim, Ki C., Army Research Lab., USA; Jun. 1999; 41p; In English

Contract(s)/Grant(s): DA Proj. 1L1-62618-AH-80

Report No.(s): AD-A365514; ARL-TR-1985; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The effects of main rotor blade ballistic damage on helicopter vibration are investigated using a comprehensive helicopter aeroelastic analysis code. Ballistic damage to the rotor blade is represented in the blade structural model as well as in the aerodynamic analysis. Each blade is treated as being composed of elastic beams undergoing flap bending, lead-lag bending, elastic twist, and axial deflections. The dynamic response of multi-bladed rotor systems is calculated from nonlinear periodic normal mode equations using a finite element in time scheme. Results are calculated for a typical soft in-plane hingeless rotor helicopter with several damage configurations. Blade damage effects are determined in terms of blade mode shapes and frequencies, blade aeroelastic response, blade bending loads, and hub-fixed system vibration. Blade dissimilarity because of ballistic damage can induce a large vibratory component with its frequency the same as the rotor revolution (1/rev) on the helicopter system.

DTIC

Vibration Mode; Numerical Analysis; Dynamic Response; Helicopters; Damage; Helicopter Tail Rotors; Aeroelasticity

19990079750 Nanjing Univ. of Aeronautics and Astronautics, Nanjing, Jiangsu, China

Transactions of Nanjing University of Aeronautics and Astronautics: Special Issue on Quality and Reliability

Zhang, A.; Jun. 1998; Volume 15, No. 1; 172p; In English

Report No.(s): PB99-164519; Copyright; Avail: National Technical Information Service (NTIS), Hardcopy

Contents include the following: Research on Cold-Expanded Hole with FEM; Robust Design and Reliability; An Introduction to New Multivariate Diagnosis Theory with Two Kinds of Quality and Its Applications; Application of Human Cognitive Model for Time-Dependent Operator Behavior in Chinese NPP; General Reliability Analysis for Two-Dimensional Slopes; Analysis and Calculation on Friction and Wear Reliability of Some Plane's Flap Mechanism; A Fault Isolation Expert System for Engine Indication and Crew Alerting System; Improving Elevator Maintenance Performance: Work Study Approach; Improvement of Maching Accuracy of Cantilever Boring Bar System Using Piezoelectric Actuator; Study on Measures of Fault Tolerance for Distributed System; Application of Quality Management in a Chinese Based Society--Hong Kong; Improvement of Product Quality and Production Process Performance in Jewelry Manufactured through 'Integrated Craftsmanship'; Managing Human Resources for Retail Service Quality; Made in Hong Kong: a Cultural Pearl Pursuing for Quality; Benefits of ISO 9000 Certification and Further Development on Quality Management; Quality Mission and Approach in Manufacturing--A Hong Kong Perspective;

NTIS

Reliability Analysis; Quality Control; Multivariate Statistical Analysis

19990079849 Naval Surface Warfare Center, Indian Head, MD USA

Helicopter Compatibility and Flashless 2.75-Inch Rocket Motor Development

Kim, Steven S., Naval Surface Warfare Center, USA; 1998 JANNAF Propulsion Meeting; Jul. 1998; Volume 1, pp. 31-44; In English; See also 19990079846; No Copyright; Avail: Issuing Activity (CPIA, 10630 Little Patuxent Pkwy., Suite 202, Columbia, MD 21044-3200), Hardcopy, Microfiche

This paper is intended to summarize the development of the helicopter compatibility and flashless 2.75-inch Rocket Motors. The helicopter compatibility rocket motor is designed to solve the incompatibility between the 2.75-Inch Rocket Motor exhaust and aircraft engines. The flashing rocket motor is a version of the helicopter compatibility rocket motor that offers enhanced aircraft safety during night operations.

Author

Compatibility; Helicopters; Rocket Engines; Fabrication

19990079881 Astrox Corp., Hampton, VA USA

Euler Calculations at Off-Design Conditions for an Inlet of Inward Turning RBCC-SSTO Vehicle

Takashima, N., Astrox Corp., USA; Kothari, A. P., Astrox Corp., USA; 1998 JANNAF Propulsion Meeting; Jul. 1998; Volume 1, pp. 407-418; In English; See also 19990079846

Contract(s)/Grant(s): NAS1-20060; NAS8-97254; No Copyright; Avail: Issuing Activity (CPIA, 10630 Little Patuxent Pkwy., Suite 202, Columbia, MD 21044-3200), Hardcopy, Microfiche

The inviscid performance of an inward turning inlet design is calculated computationally for the first time. Hypersonic vehicle designs based on the inward turning inlets have been shown analytically to have increased effective specific impulse and lower heat load than comparably designed vehicles with two-dimensional inlets. The inward turning inlets are designed inversely from inviscid stream surfaces of known flow fields. The computational study is performed on a Mach 12 inlet design to validate the performance predicted by the design code (HAVDAC) and calculate its off-design Mach number performance. The three-dimensional Euler equations are solved for Mach 4, 8, and 12 using a software package called SAM, which consists of an unstructured mesh generator (SAMmesh), a three-dimensional unstructured mesh flow solver (SAMcfd), and a CAD-based software (SAMcad). The computed momentum averaged inlet throat pressure is within 6% of the design inlet throat pressure. The mass-flux at the inlet throat is also within 7 % of the value predicted by the design code thereby validating the accuracy of the design code. The off-design Mach number results show that flow spillage is minimal, and the variation in the mass capture ratio with Mach number is comparable to an ideal 2-D inlet. The results from the inviscid flow calculations of a Mach 12 inward turning inlet indicate that the inlet design has very good on and off-design performance which makes it a promising design candidate for future air-breathing hypersonic vehicles.

Author

Euler Equations of Motion; Design Analysis; Inlet Flow; Computational Grids; Computer Aided Design; Hypersonic Vehicles

19990080050 Georgia Inst. of Tech., School of Aerospace Engineering, Atlanta, GA USA

New Approaches to HSCT Multidisciplinary Design and Optimization Final Report, Jan. 1994 - Dec. 1998

Schrage, Daniel P., Georgia Inst. of Tech., USA; Craig, James I., Georgia Inst. of Tech., USA; Fulton, Robert E., Georgia Inst. of Tech., USA; Mistree, Farrokh, Georgia Inst. of Tech., USA; July 1999; 66p; In English

Contract(s)/Grant(s): NAG1-1564; NGT-51102; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

New approaches to MDO have been developed and demonstrated during this project on a particularly challenging aeronautics problem- HSCT Aeroelastic Wing Design. to tackle this problem required the integration of resources and collaboration from three Georgia Tech laboratories: ASDL, SDL, and PPRL, along with close coordination and participation from industry. Its success can also be contributed to the close interaction and involvement of fellows from the NASA Multidisciplinary Analysis and Optimization (MAO) program, which was going on in parallel, and provided additional resources to work the very complex, multidisciplinary problem, along with the methods being developed. The development of the Integrated Design Engineering Simulator (IDES) and its initial demonstration is a necessary first step in transitioning the methods and tools developed to larger industrial sized problems of interest. It also provides a framework for the implementation and demonstration of the methodology. Attachment: Appendix A - List of publications. Appendix B - Year 1 report. Appendix C - Year 2 report. Appendix D - Year 3 report. Appendix E - accompanying CDROM.

Derived from text

Aircraft Design; Procedures; Aeroelasticity; Multidisciplinary Design Optimization

19990080053 Stanford Univ., Dept. of Aeronautics and Astronautics, Stanford, CA USA

Aero-Structural Optimization of HSCT Configurations in Transonic and Supersonic Flow Final Report, 1 Oct. 1997 - 30 Sep. 1998

Alonso, Juan J., Stanford Univ., USA; Feb. 03, 1999; 7p; In English

Contract(s)/Grant(s): NCC2-5226; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

This document outlines the progress made under NASA Cooperative Research Agreement NCC2- 5226 for the period 10/01/97-09/30/98. The work statement originally proposed was meant to extend over the period of two complete years of which only one was funded. Consequently, only a portion of the goals were achieved. Similar work will continue in our group under different sponsorship and will be available in the form of conference and journal publications. The following sections summarize the technical accomplishments obtained during the last year. Details of these accomplishments can be found in the accompanying paper that was presented at the AIAA 37th Aerospace Sciences and Exhibit Meeting which was held in Reno, NV in January of this year. The original proposal outlined a research program meant to lay down the foundation for the development of high-fidelity, fully-coupled aerodynamic/structural optimization methods applicable to a variety of aerospace applications including the design optimization of High Speed Civil Transport (HSCT) configurations. The necessary research and development work was divided into two main efforts which addressed the necessities of the long term goal. Initially, our experience in the simulation of unsteady aeroelastic flows was directly applied to existing aerodynamic optimization techniques in order to provide insight into the effects of aeroelastic deformations on the performance of aircraft which have been designed based on purely aerodynamic cost functions. The intention was to follow up this work with a detailed investigation into the basic research work that has to be completed for the development of an optimization framework which efficiently allows the truly coupled design of aero-structural systems. This

follow-up effort was not funded. The outcome of our efforts during the past year was the development of a coupled aero-structural analysis and design environment that was applied to the design of a complete aircraft configuration.

Author

Structural Analysis; Aerospace Engineering; Structural Engineering; Aircraft Configurations; Design Analysis; Optimization

19990080920 NASA Goddard Space Flight Center, Greenbelt, MD USA

The LIULIN-3M Radiometer for Measuring Particle Doses in Space and on Aircraft

Stassinopoulos, E. G., NASA Goddard Space Flight Center, USA; Stauffer, C. A., Stinger Gaffarian Technologies, USA; Dachev, T. P., Bulgarian Academy of Sciences, Bulgaria; Brucker, G. J., Radiation Effects Consultants, USA; Tomov, B. T., Bulgarian Academy of Sciences, Bulgaria; Dimitrov, P. G., Bulgarian Academy of Sciences, Bulgaria; [1999]; 22p; In English; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This paper reports on the development of a compact radiation monitor/dosimeter, the LIULIN-3M, and on extended measurements conducted on the ground and on commercial aircraft on domestic and international flights.

Author

Radiation Measurement; Commercial Aircraft; Dosage; Fabrication

19990080967 NASA Langley Research Center, Hampton, VA USA

Force and Moment Approach for Achievable Dynamics Using Nonlinear Dynamic Inversion

Ostroff, Aaron J., NASA Langley Research Center, USA; Bacon, Barton J., NASA Langley Research Center, USA; 1999; 14p; In English; Guidance, Navigation and Control, 9-11 Aug. 1999, Portland, OR, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA

Report No.(s): AIAA Paper 99-4001; Copyright; Avail: Issuing Activity, Hardcopy

This paper describes a general form of nonlinear dynamic inversion control for use in a generic nonlinear simulation to evaluate candidate augmented aircraft dynamics. The implementation is specifically tailored to the task of quickly assessing an aircraft's control power requirements and defining the achievable dynamic set. The achievable set is evaluated while undergoing complex mission maneuvers, and perfect tracking will be accomplished when the desired dynamics are achievable. Variables are extracted directly from the simulation model each iteration, so robustness is not an issue. Included in this paper is a description of the implementation of the forces and moments from simulation variables, the calculation of control effectiveness coefficients, methods for implementing different types of aerodynamic and thrust vectoring controls, adjustments for control effector failures, and the allocation approach used. A few examples illustrate the perfect tracking results obtained.

Author

Aerodynamic Characteristics; Dynamic Characteristics; Dynamic Control; Thrust Vector Control; Control Equipment

19990081086 NASA Langley Research Center, Hampton, VA USA

Progress Toward Using Sensitivity Derivatives in a High-Fidelity Aeroelastic Analysis of a Supersonic Transport

Giunta, Anthony A., National Academy of Sciences - National Research Council, USA; Sobieszczanski-Sobieski, J., NASA Langley Research Center, USA; 1998; 13p; In English; 7th; Multidisciplinary Analysis and Optimization, 2-4 Sep. 1998, Saint Louis, MO, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA

Report No.(s): AIAA Paper 98-4763; No Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

Several government/commercial off-the shelf modular software packages have been combined to perform static aeroelastic analysis and aerodynamic optimization of a generic high-speed civil transport, with the eventual goal of performing high-fidelity MultiDisciplinary Optimization (MDO). Results obtained for the aeroelastic analysis and aerodynamic optimization cases are consistent with expectation and serve as a benchmark for future results that will incorporate sensitivity derivatives from the computational fluids and structures solvers to reduce the wall-clock computational expense of high-fidelity MDO.

Author

Applications Programs (Computers); Sensitivity; Derivation; Aeroelasticity; Supersonic Transports

19990084026 Army Research Lab., Hampton, VA USA

Crash Simulation of an Unmodified Lear Fan Fuselage Section Vertical Drop Test

Fasanella, Edwin L., Army Research Lab., USA; Jackson, Karen E., Army Research Lab., USA; 1998; 9p; In English; 54th, 20-22 May 1998, Washington, DC, USA; Sponsored by American Helicopter Society, Inc., USA; No Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

The nonlinear explicit dynamic finite element code, MSC/DYTRAN, was used to simulate a 31 ft/s vertical drop test of a composite Lear Fan 2100 aircraft fuselage section, which was performed at the Impact Dynamics Research Facility of NASA

Langley Research Center. The Lear Fan fuselage section is fabricated of graphite-epoxy fabric material and is approximately 60 in. in diameter and 11 in. in length. The fuselage section consists of a composite skin with two C-frame stiffeners. The subfloor contains four aluminum keel beams, which are supported vertically and laterally with composite stanchions. Two aluminum stools, each loaded with 100 lbs. of lead mass, were mounted to the section to simulate the inertia provided by a seat and occupant. The objective of the crash analysis was to evaluate the capabilities of the MSC/DYTRAN code in predicting the response of composite airframe structural components subjected to impact loading. Correlation of the analytical results with experimental acceleration, velocity, and displacement time histories indicated good agreement. However, the success of the correlation was found to be highly dependent on correctly predicting the failure mode of the composite stanchions.

Author

Crashes; Simulation; Aircraft Structures; Fuselages; Drop Tests; Computer Programs; Impact Loads

19990087303 Air Force Research Lab., Air Vehicles Directorate, Wright-Patterson AFB, OH USA

Effect of Prolonged Electrohydrodynamic (END) Exposure on Aviation Working Fluids *Final Report, 12 Jan. 1998 - 30 Apr. 1999*

Paschkewitz, John S.; May 1999; 23p; In English

Contract(s)/Grant(s): Proj-2402

Report No.(s): AD-A366241; AFRL-VA-WP-TR-1999-3056; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Two aviation working fluids, PAO and FC-72, were exposed to pulsed high voltage for 200 hours in a simulation of electrohydrodynamic heat transfer enhancement. The fluids were analyzed for changes in chemical, physical and electrical properties. The electrode surfaces were also analyzed for any observed buildup. No bulk fluid chemical or physical property changes were observed. There was a change in the electrical properties of PAO, as well as noticeable buildup on the electrode surfaces. This buildup was attributed to electrically induced oxidation reactions. The change in electrical properties could have application of an EHD-enhanced thermal management system are discussed.

DTIC

Working Fluids; Physical Properties; Heat Transfer; Electrohydrodynamics; High Voltages

19990087362 Louisville Univ., Mechanical Engineering Dept., KY USA

Research and Development of Rapid Design Systems for Aerospace Structure

Schaeffer, Harry G., Louisville Univ., USA; Feb. 01, 1999; 15p; In English

Contract(s)/Grant(s): NCC1-261; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This report describes the results of research activities associated with the development of rapid design systems for aerospace structures in support of the Intelligent Synthesis Environment (ISE). The specific subsystems investigated were the interface between model assembly and analysis; and, the high performance NASA GPS equation solver software system in the Windows NT environment on low cost high-performance PCs.

Author

Aerospace Engineering; Design Analysis; Windows (Computer Programs); Systems Engineering; Structural Design; Computer Aided Design; Software Engineering

06

AIRCRAFT INSTRUMENTATION

Includes cockpit and cabin display devices; and flight instruments.

19990080043 NASA Marshall Space Flight Center, Huntsville, AL USA

Application of Reconfigurable Avionics for the Bantam Launch Vehicle

Wallace, Kevin Shawn, NASA Marshall Space Flight Center, USA; 1999; 10p; In English; 18th; Digital Avionics Systems, 23-29 Oct. 1999, Saint Louis, MO, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA; No Copyright; Avail: Issuing Activity, Hardcopy

The modern aerospace market is placing increasing pressure on launch costs. This is particularly true for small university science payloads, where the cost of the experiment itself is relatively low, and the launch frequency is potentially very high. It is the stated goal of NASA's Bantam Program to reduce dramatically the costs of launching this class of payloads to the order of \$1,000,000 per launch for a single 200 pound payload. The envisioned Bantam vehicle is a multi-stage reusable launch system. Meeting the Program's goal for this versatile type of vehicle requires reductions in production cost, maintenance cost, and the operation cost. However, the cost of avionics is a relatively small fraction of the overall cost of launching a payload, and a simple

reduction in the avionics costs will not achieve the Bantam goal. Only by reducing weight, volume, and power, while enhancing computational capability can the avionics be used to address the system-level cost reduction requirements.

Author

Avionics; Cost Reduction; Launch Costs; Launch Vehicles; Spacecraft Launching; Production Costs; Cost Analysis

07

AIRCRAFT PROPULSION AND POWER

Includes prime propulsion systems and systems components, e.g., gas turbine engines and compressors; and onboard auxiliary power plants for aircraft.

19990070390 Research and Technology Organization, Applied Vehicle Technology Panel, Neuilly-sur-Seine, France
Qualification of Life Extension Schemes for Engine Components *Homologation des Programmes de Prolongation du Cycle de vie des Organes Moteur*

March 1999; 172p; In English, 5-6 Oct. 1998, Corfu, Greece; See also 19990070391 through 19990070408

Report No.(s): RTO-MP-17; AC/323(AVT)TP/7; ISBN 92-837-1012-6; Copyright Waived; Avail: CASI; A08, Hardcopy; A02, Microfiche

Contains the papers presented at the Workshop on Qualification of Life Extension Schemes for Engine Components. The replacement cost of service-damaged components contributes significantly to the life cycle costs of an aero-engine. Damaged engine components also impact on the reliability and safety of aircraft. The papers discuss component damage management in turbines, including life management aspects of high cycle fatigue, and techniques for extending lives of service-damaged parts to achieve engine life cycle cost reductions, without compromising safety. Operators' needs and benefits accruing from component life extension are discussed. Various technologies available to life cycle managers for component life extension are described. The technologies include surface modification treatments and coatings, repair and refurbishment procedures, as well as improved component life cycle management practices based on damage tolerance and inspection. Emphasis is placed on the qualification testing requirements that must be satisfied to ensure that repaired or modified parts, or parts for which new life cycle management practices are applied, remain safe and reliable when returned to service.

Author

Aircraft Engines; Cost Reduction; Engine Parts; Gas Turbine Engines; Aircraft Maintenance; Operating Costs; Service Life; Life Cycle Costs; Damage Assessment; Aircraft Safety; Conferences

19990070391 Atlantis Aerospace Corp., Brampton, Ontario Canada

Aero-Engine Component Repair/Replacement Decision Factors

Hastings, R. R., Atlantis Aerospace Corp., Canada; March 1999; 6p; In English; See also 19990070390; Copyright Waived; Avail: CASI; A02, Hardcopy; A02, Microfiche

The high cost of ownership of military weapons systems coupled with shrinking defense budgets is encouraging the pursuance of alternative management strategies for cost control. Aero-engines which typically consume 30% of the life cycle costs of a fighter aircraft platform are a prime target for initiatives including: damage tolerant design practices, on-condition maintenance and the repair, refurbishment or rejuvenation of components as opposed to their replacement. While the foregoing issue address cost issues in a very direct manner, there are a number of other factors which may motivate owners of large fleets of aircrafts to pursue management by repair/refurbishment.

Author

Aircraft Engines; Fighter Aircraft; Life Cycle Costs; Cost Analysis; Failure Analysis; Aircraft Maintenance; Cost Reduction

19990070392 Bundesamt fuer Wehrtechnik und Beschaffung, Propulsion Systems Div., Manching, Germany

Cost Effectiveness of Modern Lifting Concepts: Consideration of Economical Aspects Concentrating on Group A Parts of Military Aircraft Engines

Tschirne, K. U., Bundesamt fuer Wehrtechnik und Beschaffung, Germany; Holzbecher, W., Bundesamt fuer Wehrtechnik und Beschaffung, Germany; Qualification of Life Extension Schemes for Engine Components; March 1999; 9p; In English; See also 19990070390; Copyright Waived; Avail: CASI; A02, Hardcopy; A02, Microfiche

It is an usual approach of traditional lifing procedures to perform extensive and therefore costly spinning and laboratory tests with subsequent sampling programmes aiming at the maximum usage of fracture critical parts, so called group-Aparts. Experience on military programmes has shown that this approach does not take into account all the aspects related to the real in-service situation. In order to avoid engine removals and disassemblies due to life-expired parts, causing major expenses, it becomes

necessary to retire parts when they become available on the basis of natural arisings, i. e. at the most economical and suitable point in time. The aim of the presentation is to encourage both the manufacturer and operator of military engines to instigate a detailed review of their current lifing policy as far as the remaining life at the point of retirement is concerned. Furthermore, some aspects concerning the philosophy of the required (desired) specified life for an engine and its components are highlighted.

Author

Cost Effectiveness; Aircraft Engines; Life (Durability)

19990070393 Standard Aero Ltd., Winnipeg, Manitoba Canada

International Acceptance of Commercial Repair Approvals

Thomas, Wayne, Standard Aero Ltd., Canada; Junkin, Brent, Standard Aero Ltd., Canada; March 1999; 5p; In English; See also 19990070390; Copyright Waived; Avail: CASI; A01, Hardcopy; A02, Microfiche

As the military increasingly adopts commercial standards for the maintenance of "dual use" aircraft, commercial repair approval and it's methodology is becoming increasingly relevant in the military world. Component repair development is not limited to the MANUFACTURER. The repair marketplace is global with independent facilities operating around the world. The authority to issue approvals for aeronautical product repair procedures lies with the National Aviation Authority (NAA). Some NAA's have implemented a system of delegation to enhance the efficiency and effectiveness of the approval process. The privileges and responsibilities of delegated authority may be granted to operators, independent repair stations, qualified individuals, or the manufacturer. This paper describes how the commercial system works to obtain approval for a new repair scheme, and describes some delegation systems.

Author

Aircraft Maintenance; Logistics; Checkout

19990070394 Air Force Research Lab., Materials and Manufacturing Technology Directorate, Wright-Patterson AFB, OH USA

High Cycle Fatigue Life Management in Gas Turbine Engines

Nicholas, T., Air Force Research Lab., USA; March 1999; 9p; In English; See also 19990070390; Copyright Waived; Avail: CASI; A02, Hardcopy; A02, Microfiche

High Cycle Fatigue (HCF) failures in materials used in rotating components of gas turbine engines have often been found to be attributable to fatigue loading on materials which have sustained damage from other sources. Damage can be present in the form of initial material or manufacturing defects, or can develop during service operation. Three major sources of in-service damage have been identified which can alter the HCF resistance individually or in conjunction with one another: Low cycle fatigue (LCF), foreign object damage (fod) and fretting. Methodologies for treating such damage in establishing material allowables are considered. Some recent results on the effects of damage on the Haigh diagram and a discussion of the life management aspects of HCF are presented.

Author

Damage; Defects; Fatigue (Materials); Fatigue Life; Foreign Bodies; Gas Turbine Engines; Life (Durability); Engine Failure; Operational Hazards

19990070395 Rolls-Royce Ltd., Turbine Systems-Engineering, Bristol, UK

Cost Benefit Analysis for the Use of Better Turbine Materials and Technology Including Predicted Life Improvements

Williams, T. J., Rolls-Royce Ltd., UK; March 1999; 6p; In English; See also 19990070390; Copyright Waived; Avail: CASI; A02, Hardcopy; A02, Microfiche

The new materials and technologies being identified to give an improved engine product have a number of interacting effects. For example, a more advanced turbine blade cooling system may offer improved performance and or life but may also increase the cost of each blade. Life cycle cost methods are used in the aero engine industry to establish the overall operating cost for a particular engine / airframe combination. As the name implies the total cost of operation of the engine over its scheduled service life can be established. This paper will demonstrate how the use of life cycle costing techniques at the early stage of life extension proposals can influence the design and lead to a more economic design solution. In the study the effect of initial costs (material and manufacture) were traded against performance and life improvement to optimize the most cost effective design. The results of the study have been used to identify what manufacturing cost reduction must be achieved to benefit fully from performance and life improvements during the overall life of the engine.

Author

Cost Effectiveness; Cost Reduction; Turbine Blades; Technology Assessment; Life (Durability); Service Life; Life Cycle Costs

19990070396 Vlaamse Instelling voor Technologisch Onderzoek, Mol, Belgium

Low Friction Diamond-Like Carbon Coatings for Engine Applications

Smeets, J., Vlaamse Instelling voor Technologisch Onderzoek, Belgium; March 1999; 3p; In English; See also 19990070390; Copyright Waived; Avail: CASI; A01, Hardcopy; A02, Microfiche

The presentation discusses the low friction diamond-like carbon coatings and deposition methods for engine applications. The three types of coating types discussed are: (1) pure diamond-like Carbon, (2) doped diamond like carbon and (3) Gradient and multilayer coatings. The properties of each of the three coating types is reviewed. Six characteristics of vapor based deposition technology are discussed deposition methods are reviewed: (1) vacuum technology; (2) Physical Vapor Deposition (PVD), starting from solids; (3) Chemical vapor deposition, starting from gases; (4) flux of radicals and ions to the substrate (5) ion flux/ion energy determines film properties, and (6) Plasma assisted CVD (PACVD), with particular attention being paid to the characteristics of PACVD. The possible applications in many areas for low friction diamond-like carbon coatings are reviewed. Specific attention is paid to the use of the coatings on engine powertrain components. In conclusion the talk reviews the diamond like carbon coatings properties, and the engine applications. This is presented in view graph format.

CASI

Coating; Deposition; Diamonds; Engine Parts; Vapor Deposition; Diamond Films; Vacuum Deposition

19990070399 Liburdi Engineering Ltd., Dundas, Ontario Canada

Enabling Technologies for Turbine Component Life Extension

Liburdi, J., Liburdi Engineering Ltd., Canada; March 1999; 7p; In English; See also 19990070390; Copyright Waived; Avail: CASI; A02, Hardcopy; A02, Microfiche

The evolution in materials and turbine design has resulted in the parallel development of advanced equipment and processes capable of manufacturing and repairing the critical engine components. Modern, vision based automated welding systems are now essential for precise, low heat welding of crack sensitive alloy, while unique powder metallurgy process such as LPM-TM allows repairs to be engineered for higher localized strength or better wear properties such as abrasive tips. Significant changes have also occurred in the stripping and coating processes with the introduction of sophisticated vapor based technologies that are beyond reach of smaller repair facilities. The availability and costs associated with these enabling technologies, along with the difficulty in obtaining approvals, will serve to further consolidate the industry and restrict the sources for advanced component repairs.

Author

Engine Parts; Maintenance; Turbines; Welding; Powder Metallurgy; Turbine Blades; Brazing; Coating

19990070400 Orenda Aerospace Corp., Advanced Materials and Energy Systems, Gloucester, Ontario Canada

Development of a Qualification Methodology for Advanced Gas Turbine Engine Repairs/Reworks

Patnaik, P. C., Orenda Aerospace Corp., Canada; Thamburaj, R., Orenda Aerospace Corp., Canada; March 1999; 11p; In English; See also 19990070390; Copyright Waived; Avail: CASI; A03, Hardcopy; A02, Microfiche

In this paper the engine and component qualification test requirements with specific application to component repairs/reworks of Civilian and US military specifications and standards for turboshaft, turboprop, turbofan and turbojet engines have been reviewed and a methodology developed. Having identified that repairs were feasible and cost beneficial, a review of civil and military airworthiness guidance was conducted in order to identify a process that would ensure that a high state of airworthiness was maintained and which would easily translate to civil requirements. Failure mode, effects and criticality analysis, as a reliability analysis tool, for Gas Turbines has been developed for component repair/reworks. As part of the development of a FMECA engineering tool, a specific procedure has been developed for performing FMECA on various type of gas turbines, including turbojet, turbofan, turboshaft and turboprop engines. According to the specification established by Orenda and GasTOPS (the sub-contactor), the developed software contains the following: (1) System definition with iconic display, (2) Complete FMEA capable to use either hardware or functional approach or a combination of both, (3) Complete CA capability with either qualitative or quantitative method and, (4) FMECA report format to help the users to generate a complete FMECA report. The software is a generic FMECA tool for the applications to various types of aircraft engine systems, including turbojet, turbofan, turboshaft turboprop and etc. The test of the software has been carried out by both GasTOPS and Orenda using a set of F-404 data. In terms of a Qualification Methodology Development, coupon, component and full scale engine testing are required by all standards to show compliance with the structural integrity and durability requirements (e.g. low cycle fatigue, high cycle fatigue, creep, vibration, containment) for gas path structural components under different environmental operating conditions. An Engine Repair Structural Integrity Program (ERSIP) Standard was proposed which is an integral part of the Qualification Methodology for engine component repairs. The ERSIP Standard incorporates the damage tolerance concept as

required in MIL-STD-1783 (USAF-Engine Structural Integrity Program (ENSIP)). The ENSIP Standard establishes the repair development and repair qualification tests to ensure structural integrity and performance throughout the repair life cycle.

Author

Engine Tests; Equipment Specifications; Failure Analysis; Turbojet Engines; Turboprop Engines; Turboshfts; Structural Failure; Maintenance; Life (Durability)

19990070401 Lufthansa Technik A.G., Hamburg, Germany

Advanced Recontouring Process for Compressor Blades

Panten, M., Lufthansa Technik A.G., Germany; Hoenen, H., Technische Hochschule, Germany; March 1999; 5p; In English; See also 19990070390; Copyright Waived; Avail: CASI; A01, Hardcopy; A02, Microfiche

This paper deals with the re-contouring of the leading edges contours of compressor airfoils by application of a newly developed method for the profile definition. Lufthansa Technik AG and the Institute of Jet Propulsion and Turbomachinery, Aachen University of technology have developed the Advanced Recontouring Process (ARP) which is an automated inspection and grinding process to produce defined and airflow optimized leading edge profiles with high reproducibility.

Author

Air Flow; Airfoils; Compressor Blades; Contours; Jet Propulsion; Turbomachinery; Leading Edges; Erosion; Forming Techniques

19990070402 Societe Nationale d'Etude et de Construction de Moteurs d'Aviation, CFM56 Product Support, Melun, France
Repair Developments to Fit Customer Needs

Burlon, Daniel, Societe Nationale d'Etude et de Construction de Moteurs d'Aviation, France; March 1999; 3p; In English; See also 19990070390; Copyright Waived; Avail: CASI; A01, Hardcopy; A02, Microfiche

This presentation describes the repair development process from identification of repair needs to repaired parts installed on an engine. The key factors in this process will be identified and economical inputs will be highlighted. The presentation will show how and why Snecma-services involves customers in identification of repair need and in the evaluation process. This process is called : Top Repair Program.

Author

Aircraft Maintenance; Deterioration; Identifying; Fault Detection; Ground Support Equipment; Shops

19990070403 General Electric Co., Aircraft Engines, Cincinnati, OH USA

Fracture Mechanics Evaluation of Weld Repaired Seal Teeth for Life Extension of Aircraft Gas Turbine Engine Components

Domas, P. A., General Electric Co., USA; March 1999; 8p; In English; See also 19990070390; Copyright Waived; Avail: CASI; A02, Hardcopy; A02, Microfiche

Typical aircraft gas turbine engine rotating air seals incorporate radial protruding, knife-like, circumferential seal teeth at the outer diameter that intrude into a surrounding abradable shroud, forming a seal to unwanted air passage. The thin teeth are susceptible to wear in operation and nicks and dents during assembly and disassembly for overhaul. It is economically desirable to be able to repair such worn or damaged seals for return to service. A potential repair process is to grind down the tip of a damaged tooth, rebuild it with overlaid layers of similar alloy weld metal and machine the built up material back to final shape. A complication is that the weld material may contain porosity or other microstructural features that can act as a surface or subsurface fatigue crack initiation sites and limit the cyclic life capability of a repaired tooth. This paper discusses an experimental fatigue test program and associated test specimen and component fracture mechanics analyses conducted to assess the viability of a seal tooth weld repair process. The role of simulated component fatigue testing, nondestructive evaluation, fatigue and residual life prediction, and design trade studies in determination of life extension plans is discussed. Complication and issues that arise and potential means of addressing these are emphasized.

Author

Crack Initiation; Engine Parts; Fatigue Tests; Fracture Mechanics; Gas Turbine Engines; Life (Durability); Nondestructive Tests; Seals (Stoppers); Surface Cracks; Wear

19990070405 Defence Evaluation Research Agency, Farnborough, UK

The Development of Life Extension Methods for Fracture Critical Aero-Engine Components

Boyd-Lee, A. D., Defence Evaluation Research Agency, UK; Harrison, G. F., Defence Evaluation Research Agency, UK; March 1999; 10p; In English; See also 19990070390; Copyright Waived; Avail: CASI; A02, Hardcopy; A02, Microfiche

Service experience and the rapid advancement of understanding frequently prompt revisions of the declared service lives for aeroengine components. Downward revisions can occur because: 1) ex-service disc tests show that engine operation is harder on components than was estimated at design; 2) in-service cracks, catastrophic failures, and ex-service testing show that some failure mechanisms differ from those identified at design; 3) improvements to service usage models has resulted in more conservative exchange rates; 4) refined analyses for some components show the operating stresses are higher than those estimated at design; and 5) some component design modifications cause a change in a life limiting critical area, etc. From whatever cause, the imposition of service life reductions often results in unexpected component life expires. The resulting costs of grounding the aircraft and of engine removal can be many times greater than the component replacement costs. Thus, demand for life extensions is usually aimed at life reduced parts. Three life extension methods developed to meet this need are presented. Firstly, methods of life extension for crack tolerant component designs are outlined. Secondly, a robust statistical method for exploitation of non-finite results is demonstrated to provide significant life extensions. (A non-finite result is associated with a test stopped before reaching the desired component dysfunction point). Finally, in view of the importance of risk assessment modelling in the more critical cases, the derivation of a risk of fatigue failure model is presented. In this paper, the life-to-first-crack concept and the '2/3 dysfunction' criterion are used as standard 'reference lives' or 'stakes in the ground' relative to which life extensions are measured.

Author

Technology Assessment; Service Life; Failure; Aircraft Engines

19990070406 Motoren- und Turbinen-Union G.m.b.H., Dept. TPMR and TPMM, Munich, Germany

Critical Parts' Life Extension Based on Fracture Mechanics

Bluemel, Peter, Motoren- und Turbinen-Union G.m.b.H., Germany; Broede, Juergen, Motoren- und Turbinen-Union G.m.b.H., Germany; March 1999; 7p; In English; See also 19990070390; Copyright Waived; Avail: CASI; A02, Hardcopy; A02, Microfiche

The classical method for fracture critical parts lifing is the safe life approach, where 'safe life' in fact means safe crack initiation life. In many cases, the released life of a critical part can be extended if the lifing concept is supplemented with the safe crack propagation life approach. In particular, if the life limiting area of a part possesses substantial damage tolerance capability, the possible parts' life extension will be significant. The underlying safety criteria and the statistical treatment of the test results for both the approaches are equivalent, but for prediction of the crack propagation life the application of fracture mechanics methods and the knowledge of material crack growth behaviour are necessary. Crack growth is directly related to the stress intensity factor. The stress intensity factor itself depends on the currently applied stress field (which in turn depends on mechanical and thermal loading), the geometry of the component, and the current shape of the crack front. Load and crack front shape vary with time. Two methods are discussed how the stress intensity factor can be obtained, namely experimentally from crack growth tests of the real component or analytically from 3D finite element calculations. Service life of an aero engine component is determined by its released life and its life consumption caused by operational usage. Therefore, it is important to monitor the operational usage either by on-board monitoring devices or by the application of adequate cyclic exchange rates (r-factors). Experience gained with the RB199 IP compressor and IP turbine (where this safe crack propagation life approach is utilized) shows that crack propagation -factors are by a factor of 2 - 3 higher than crack initiation ,B-factors. Nevertheless, the achieved life extension in terms of engine flying hours is about 40%.

Author

Rates (Per Time); Tolerances (Mechanics); Aircraft Engines; Life (Durability); Fracture Mechanics; Service Life

19990070407 NASA Lewis Research Center, Cleveland, OH USA

Damage Tolerance and Reliability of Turbine Engine Components

Chamis, Christos C., NASA Lewis Research Center, USA; March 1999; 13p; In English; See also 19990070390; Copyright Waived; Avail: CASI; A03, Hardcopy; A02, Microfiche

A formal method is described to quantify structural damage tolerance and reliability in the presence of multitude of uncertainties in turbine engine components. The method is based at the materials behaviour level where primitive variables with their respective scatters are used to describe the behavior. Computational simulation is then used to propagate those uncertainties to the structural scale where damage tolerance and reliability are usually specified. Several sample cases are described to illustrate the effectiveness, versatility, and maturity of the method. Typical results from these methods demonstrate that the methods are mature and that they can be used for future strategic projections and planning to assure better, cheaper, faster, products for competitive advantages in world markets. These results also indicate that the methods are suitable for predicting remaining life in aging or deteriorating structures.

Author

Damage; Deterioration; Engine Parts; Management Planning; Predictions; Reliability; Turbine Engines; Aircraft Maintenance; Simulation; Failure Modes; Structural Analysis; Probability Theory; Damage Assessment

19990070408 Technical Univ. of Lisbon, Portugal

Life Extension Methodology Based on Creep-Fatigue Models

Branco, C. Moura, Technical Univ. of Lisbon, Portugal; Sousae Brito, A., Technical Univ. of Lisbon, Portugal; Byrne, J., Portsmouth Univ., UK; March 1999; 19p; In English; See also 19990070390

Contract(s)/Grant(s): AGARD Proj. P111; Proj. CCI Defesa 07/91; Copyright Waived; Avail: CASI; A03, Hardcopy; A02, Microfiche

The first part of this paper presents the results of a detailed study carried out in the nickel base superalloy IN718 used in turbine discs where fatigue and creep crack growth rate data (FCGR and CCGR) was obtained at 600C in CT and CC specimens tested at different values of stress ration and dwell time at maximum load (frequency). In the second part of the paper a presentation is made of creep-fatigue models and also the results obtained with a computer program developed by the authors, which is able to make a comparison between the experimental data obtained for the FCGR in creep-fatigue situation and the equivalent results predicted by the models. This methodology can be directly used, with great advantages, in predictions of life extension in flawed components.

Author

Computer Programs; Crack Propagation; Creep Properties; Heat Resistant Alloys; Nickel Alloys; Turbines; Disks; Cracking (Fracturing); Fatigue (Materials); Mathematical Models; Aircraft Maintenance

19990070432 Defence Science and Technology Organisation, Airframes and Engines Div., Melbourne, Australia

Engine Gas Path Condition Assessment

Frith, Peter, Defence Science and Technology Organisation, Australia; Workshop on Helicopter Health and Usage Monitoring Systems; March 1999, Pt. 2, pp. 125-135; In English; See also 19990070423; Copyright; Avail: Issuing Activity (DSTO Aeronautical and Maritime Research Lab., PO Box 4331, Melbourne, Victoria 3001, Australia), Hardcopy, Microfiche

Contents include the following: engine diagnostic and acceptance system, interactive fault diagnosis isolation system, and automated diagnostic and acceptance test system.

CASI

Helicopter Control; Gas Path Analysis; Engine Monitoring Instruments

19990071048 Defence Evaluation Research Agency, Propulsion Dept., Farnborough, UK

A Synthesis of NASA Compressor Rotor 37 Using a 3D CFD Code

Calvert, W. John, Defence Evaluation Research Agency, UK; Verification of Design Methods by Test and Analysis: Proceedings; 1998, pp. 6.1 - 6.11; In English; See also 19990071044; Copyright; Avail: Issuing Activity (The Royal Aeronautical Society, 4 Hamilton Place, London, W1V 0BQ, UK), Hardcopy, Microfiche

CFD codes are now an essential part of the design system for the turbomachinery of modern gas turbine engines. In order to gain the maximum benefit from the codes it is necessary to study their application to representative test cases. In this way the code performance can be evaluated, best practice can be formulated and requirements for future improvements can be identified. NASA rotor 37 is one of the best high-speed compressor cases currently available. Detailed measurements of its performance were taken by NASA in order to provide a blind test case for an ASME exercise on CFD code evaluation, and further studies have since been carried out by NASA and by an AGARD Working Group. Despite this, there are still uncertainties about some aspects of the flow and it is necessary to interpret the data carefully. At DERA the case has been used in developing the TRANSCode 3D viscous flow code to provide more accurate predictions of transonic flows in axial compressors. Initial calculations using the Baldwin - Lomax algebraic turbulence model were consistent with the results from other codes using this model and overestimated the rotor pressure ratio. Calculations using the Spalart - Allmaras one-equation model are more successful and suggest that laminar flow and transition are important features in rotor 37, as well as shock wave/boundary layer interactions. Inclusion of the hub leakage flow effects identified by NASA is also necessary, and heat transfer to the casing may be a factor. It is hoped that the discussions of these effects will help other workers using this test case.

Author

Computational Fluid Dynamics; Compressor Rotors; Three Dimensional Flow; Turbocompressors; Gas Turbine Engines; Engine Design

19990071050 Rolls-Royce Ltd., Derby, UK

The Effect of Pressure Probe Characteristics on the Validation of Modelled Aero-Engine Compressor Blades

Smout, P. D., Rolls-Royce Ltd., UK; Ivey, P. C., Cranfield Univ., UK; Verification of Design Methods by Test and Analysis: Proceedings; 1998, pp. 8.1 - 8.14; In English; See also 19990071044; Copyright; Avail: Issuing Activity (The Royal Aeronautical Society, 4 Hamilton Place, London, W1V 0BQ, UK), Hardcopy, Microfiche

Three dimensional, viscous flow solvers are finding increasing use in the design of aero-engine compressor blading. Low-speed, large scale compressor rig testing offers a cost effective means of validating these design methods, but requires instrumentation capable of returning reliable and repeatable measurements of the highly complex flow fields. This paper reviews some of the uncertainties associated with diagnostic techniques commonly used in low speed compressor testing. In particular, cobra and wedge type pressure probes fail to measure the correct static pressure and yaw angle when close to the compressor outer annulus wall. Parametric studies supported by flow visualisation and a CFD solution of the local flow field were undertaken to understand this so called 'wall-proximity' effect, and are presented here. A method for correcting this effect by adjusting the probe calibration maps is developed. The paper concludes by considering the implications of this in validating compressor design methods.

Author

Compressor Blades; Three Dimensional Flow; Mathematical Models; Flow Distribution; Pressure Sensors

19990071051 Defence Evaluation Research Agency, Propulsion Dept., Farnborough, UK

Low-Speed Compressor Tests for Code Validation and for Simulating High-Speed Designs

Lyes, P. A., Defence Evaluation Research Agency, UK; Ginder, R. B., Defence Evaluation Research Agency, UK; Verification of Design Methods by Test and Analysis: Proceedings; 1998, pp. 9.1 - 9.11; In English; See also 19990071044; Original contains color illustrations; Copyright; Avail: Issuing Activity (The Royal Aeronautical Society, 4 Hamilton Place, London, W1V 0BQ, UK), Hardcopy, Microfiche

This paper describes the use of low-speed multi-stage compressor testing to simulate the aerodynamics of high-speed designs and also to validate 3D (three dimensional) viscous modelling methods employed for both analysis and design. It covers two design/test programmes that have been carried out by DERA on a 4-stage low-speed research compressor at Cranfield University. The first set of tests involved conventional blading whose design was based on an embedded stage from the DERA C 147 highly-loaded high-speed compressor. The intention was to investigate the relevance of low-speed testing by acquiring detailed aerodynamic measurements and undertaking comparisons with corresponding high-speed data. The opportunity was also taken to use the low-speed test data to validate flowfield predictions carried out using the DERA TRANSCode 3D viscous solver. This work gave encouragement that the low-speed environment was representative and that the modelling, although suffering from some shortcomings, was adequate. It also gave sufficient confidence to redesign the low speed blading using the 3D CFD, with the principal aim of reducing the aerodynamic losses in the critical end-wall regions. This revised blading was manufactured and tested for comparison with the datum build results and with design predictions, providing the opportunity to verify use of the code for design purposes. The paper overviews the design of both the datum and advanced low-speed blading standards. It then describes the comparisons undertaken for the datum build with both CFD predictions and high-speed data, and gives predictions and preliminary test results for the advanced blading. Important conclusions are drawn concerning the degree to which low-speed testing is relevant and the applicability of the CFD modelling method employed.

Author

Performance Tests; Applications Programs (Computers); Program Verification (Computers); Computerized Simulation; Turbocompressors; Design Analysis

19990071054 Oxford Univ., Dept. of Engineering Science, Oxford, UK

Experimental Simulation and Numerical Modelling of Foreign Object Damage in Aircraft Gas Turbines

Williams, D. P., Oxford Univ., UK; Nowell, D., Oxford Univ., UK; Verification of Design Methods by Test and Analysis: Proceedings; 1998, pp. 12.1 - 12.8; In English; See also 19990071044; Copyright; Avail: Issuing Activity (The Royal Aeronautical Society, 4 Hamilton Place, London, W1V 0BQ, UK), Hardcopy, Microfiche

The programme of work outlined in this paper is designed to help gain a deeper understanding of the mechanisms involved in Foreign Object Damage (or FOD) sustained by jet engines during their service lives. A ballistic facility has been developed at the University Technology Centre for Solid Mechanics in Oxford that is capable of reproducing, on test blades, damage equivalent to that seen in service. The gas gun is used to fire steel balls of various sizes at the leading edges of stationary compressor blades. Several sets of experiments have been performed to investigate the type of damage resulting from different velocities of the projectile. Three categories of damage have been observed; a dent, a dent with a tear and a complete perforation. A set of 15 damaged blades (5 of each damage category) have been fatigue tested at Rolls-Royce in Bristol. Fatigue cracks have been seen to initiate from the damaged area and then propagate towards the trailing edge of the blade in a straight line. It was found that the "dent and tear" was the type of damage most detrimental to fatigue life. The "dent" and "perforation" categories showed similar fatigue lives. In parallel with the experimental work, the numerical modelling package 'Dyna3D' has been used to simulate the impact experiments on computer.

This finite element package has proved capable of recreating the plastic deformation seen in the damage zone, although further work is in progress to model the tearing and failure of the material that occurs during the higher velocity impacts.

Author

Mathematical Models; Damage; Gas Turbine Engines; Aircraft Engines; Foreign Bodies; Computerized Simulation

19990071055 Nottingham Univ., Dept. of Mechanical Engineering, UK

Elastic-Plastic Buckling of Shafts

Robotham, W. S., Nottingham Univ., UK; Hyde, T. H., Nottingham Univ., UK; Williams, E. J., Nottingham Univ., UK; Taylor, J. W., Rolls-Royce Ltd., UK; Verification of Design Methods by Test and Analysis: Proceedings; 1998, pp. 14.1 - 14.14; In English; See also 19990071044; Copyright; Avail: Issuing Activity (The Royal Aeronautical Society, 4 Hamilton Place, London, W1V 0BQ, UK), Hardcopy, Microfiche

There is an ever increasing demand for more powerful and efficient aero-engines. One result of these demands is the need to consider ways of increasing the torque transmitted by shafts, whilst also reducing their dimensions and weight. This need for ever lighter, higher performance shafts and the use of features such as the triple spool engine configuration, can result in the shafts being relatively thin walled. A research project has been carried out to investigate the factors influencing the instability, in particular, the torsional buckling of shaft sections in order to provide the basis for an improved analysis method applicable to typical gas turbine aero-engine components. The analysis part of the research was conducted by the Finite Element Method (FEM) using ABAQUS version 5.6 (a nonlinear FE software package). Validation was achieved by using the results of a limited number of experimental tests. An analysis method has been developed which involves the use of a perturbation approach to model the geometric imperfections in plain shafts. The perturbations are based upon the buckling mode shapes calculated by eigenvalue analyses. Parametric analyses of plain shafts and shafts with holes have been performed. This paper contains the results of these parametric analyses and the validity experimental test results.

Author

Engine Parts; Shafts (Machine Elements); Torque; Elastic Properties; Plastic Properties; Finite Element Method; Elastic Buckling; Applications Programs (Computers)

19990071056 Eidgenoessische Technische Hochschule, Turbomachinery Lab., Zurich, Switzerland

Towards Reliable Computations for a Subsonic Turbine

Casciaro, C., Eidgenoessische Technische Hochschule, Switzerland; Sell, M., Eidgenoessische Technische Hochschule, Switzerland; Gyarmathy, G., Eidgenoessische Technische Hochschule, Switzerland; Verification of Design Methods by Test and Analysis: Proceedings; 1998, pp. 15.1 - 15.10; In English; See also 19990071044; Copyright; Avail: Issuing Activity (The Royal Aeronautical Society, 4 Hamilton Place, London, W1V 0BQ, UK), Hardcopy, Microfiche

The research aim is to identify and clarify those issues affecting code assessment in turbine steady and subsonic flow regime. In order to validate tools and methodology a detailed and precise data set obtained in the Annular Cascade Test Stand of the ETH Turbomachinery Laboratory, Zurich, Switzerland with a single prismatic blade row in steady flow has been critically contrasted to the results. Many points of interest have been considered covering a wide area of computational issues. Three operating points in the subsonic regime have been investigated and, for one of these, tip clearance effects have been investigated by varying the gap height. The flow has been computed in a two- and three dimensional domain; as viscous and inviscid; laminar and fully turbulent. In the latter computations the Kato-Lauder and k-epsilon models have been compared and the inlet free-stream turbulence values varied. As commercial codes generally apply wall laws, the logarithmic velocity profile is set against a two layer model. Under a numerical point of view first the effects of grid refinement have been addressed. Furthermore the importance of high-order numerical smoothing schemes is shown. In fact the ultimate aim of the work is not to produce computations which, through very fine meshes or high order schemes are computationally unfeasible within an industrial design context, but to produce clear, unambiguous advice as how to achieve the best results with currently available industrial tools.

Author

Computation; Subsonic Flow; Velocity Distribution; Computational Grids; K-Epsilon Turbulence Model; Gas Turbines

19990071057 Motoren- und Turbinen-Union G.m.b.H., Munich, Germany

Experimental Investigations into Turbo Engine Designs

Heitmeir, F. J., Motoren- und Turbinen-Union G.m.b.H., Germany; Radons, U., Motoren- und Turbinen-Union G.m.b.H., Germany; Heisler, A., Motoren- und Turbinen-Union G.m.b.H., Germany; Artmeier, M., Motoren- und Turbinen-Union G.m.b.H., Germany; Verification of Design Methods by Test and Analysis: Proceedings; 1998, pp. 16.1 - 16.9; In English; See also 19990071044; Copyright; Avail: Issuing Activity (The Royal Aeronautical Society, 4 Hamilton Place, London, W1V 0BQ, UK), Hardcopy, Microfiche

The ever increasing demands in terms of performance and cost-effectiveness have taken the advanced aero engine to the limits of what is technologically feasible. On the other hand, decreasing profits require, among other things, a highly efficient development phase. With the emergence of computer systems with enhanced capabilities analytical predictions have become a valuable development tool. Highly sophisticated programs are available, which allow a great variety of physical effects to be precisely predicted. This was not conceivable a decade ago. Despite the wide-spread use of analytical predictions, experiments and tests are still indispensable. The verification and adjustment of the highly sophisticated analytical tools as well as system verifications still require complex test items to be tested in even more complex test facilities. This calls for an integrated approach and a highly skilled workforce. This paper gives at first a rough overview of the different fields in which testing is mandatory to ensure an efficient engine development process. One important goal is the optimization of the engine cooling air system. High-pressure turbine vanes are highly-loaded components with a sophisticated internal cooling system. Knowledge of the heat transfer coefficients is therefore essential to ensure the design life of the turbine vanes on the one hand and to avoid overcooling which would adversely affect engine efficiency on the other hand. A unique procedure is presented for the heat transfer analysis in very complex geometries such as internal cooling structures or film cooled structures. The second example covers the optimization of low-pressure turbines. Although turbine efficiencies appear to have reached a point where no further improvement is possible analytical predictions have shown that, in efficiency of low-pressure turbines by optimizing the stator vane positions. to verify this, an experimental investigation with a dedicated test set up was performed.

Author

Experimentation; Design Analysis; Turbines; Aircraft Engines; Turbojet Engines; Cost Effectiveness; Performance Tests; Prediction Analysis Techniques; Engine Design

19990071058 Rolls-Royce Ltd., Turbine Engine Systems, Bristol, UK

Validation of Advanced Computational Fluid Dynamics in the Design of Military Turbines

Gwilliam, N. J., Rolls-Royce Ltd., UK; Kingston, T. R., Rolls-Royce Ltd., UK; Verification of Design Methods by Test and Analysis: Proceedings; 1998, pp. 17.1 - 17.11; In English; See also 19990071044; Copyright; Avail: Issuing Activity (The Royal Aeronautical Society, 4 Hamilton Place, London, W1V 0BQ, UK), Hardcopy, Microfiche

Today's design of turbine blade challenges the designer to meet the demanding requirements of overall increase in engine performance - more power for the same weight, greater engine efficiency and fuel economy. This has resulted in designs to cater for higher blade loading and faster rotational speeds. to achieve this, highlift shroudless designs are being adopted. One of the greatest challenges to the aerodynamic designer is the design of such blading so that the additional losses incurred, shock losses, greater secondary flows and susceptibility to tip clearance are minimized. to do so, it is essential to be able to carry out an accurate three-dimensional analysis of the flow within the stage. This is achieved using computational fluid dynamics. This paper aims to describe and evaluate some of the tools available at Rolls Royce plc. for the numerical simulation of turbine flows. It was generated as part of a study to analyse a 'datum' and 'highlift' HP (high pressure) turbine, so as to establish both where losses occurred, and which CFD (Computational Fluid Dynamics) codes could best analyse the blading.

Author

Computational Fluid Dynamics; Design Analysis; Military Technology; Computerized Simulation; Gas Turbines; Engine Design

19990071059 Defence Evaluation Research Agency, Farnborough, UK

An Evaluation of the Performance of a Modern Shroudless HP Turbine Using Unsteady CFD

Smith, G. C., Defence Evaluation Research Agency, UK; Stapleton, A. W., Defence Evaluation Research Agency, UK; Verification of Design Methods by Test and Analysis: Proceedings; 1998, pp. 18.1 - 18.11; In English; See also 19990071044; Original contains color illustrations

Contract(s)/Grant(s): CEC-AER2-CT92-0044; Copyright; Avail: Issuing Activity (The Royal Aeronautical Society, 4 Hamilton Place, London, W1V 0BQ, UK), Hardcopy, Microfiche

This paper presents a CFD analysis of the unsteady aerodynamics of an HP turbine, and compares the results with experimental data acquired on a transient turbine test facility. The 2D code UNSFLO and the 3D code Un-NEWT are shown to agree well with the measured mid span unsteady pressures. Use of these solutions to interpret the measured data indicates that the rotor pressure surface is strongly influenced by the NGV potential flow field, while the suction surface shows evidence of a wake shock/interaction. Loss generation within the stage is shown to be concentrated at the end walls, with the rotor tip leakage flow being a major contributor. The Un-NEWT solution was modified to include a hot streak at stage inlet, representative of the exit temperature profile of a modern military combustor. Hot/cold fluid segregation is shown to occur in the rotor passage. Hot fluid migrates to the pressure surface, and is drawn over the tip of the unshrouded rotor, giving the potential for locally high heat transfer.

Author

Gas Turbines; Shock Wave Interaction; Heat Transfer; Flow Distribution; Computational Fluid Dynamics; Unsteady Flow; Applications Programs (Computers); Program Verification (Computers)

19990071176 Naval Air Warfare Center, Weapons Div., China Lake, CA USA

Large Engine Uncontained Debris Analysis *Final Report*

Franeknberger, C. E.; May 1999; 100p; In English

Contract(s)/Grant(s): DTFA-03-95-X-90019

Report No.(s): PB99-154569; DOT/FAA/AR-99/11; No Copyright; Avail: CASI; A02, Microfiche; A05, Hardcopy

The Naval Air Warfare Center has conducted an analysis to define the characteristics of large commercial transport turbine engine uncontained debris. The objective of the analysis was to define the debris size, weight, exit velocity, and trajectory that can be used to update Advisory Circular (AC) 20-128A. The effort was conducted by gathering historical data from uncontained engine failures. This data included, when available, phase of flight, engine operating condition, the failed engine component, aircraft damage location, and damage size. With this basic information, debris size was correlated to damage size. A methodology was developed to estimate debris exit velocity. Representative engine cases and cowls were defined and existing ballistic penetration equations used to calculate debris exit velocity. This analysis was conducted for disk and blade failures on fan, compressor, and turbine components. Looking at the debris trajectories, the analysis shows that the trajectories defined in AC20-128A are too narrow and should be expanded significantly. Also, the analysis highlights the fact that during an uncontained event the aircraft is subjected to multiple 'small' fragment impacts, not just a single impact. It is the combined effects from the small fragments that pose the highest hazard potential to the aircraft.

NTIS

Aircraft Engines; Turbine Engines; Debris; Engine Design; Trajectory Analysis

19990076732 General Electric Co., Aircraft Engines, Cincinnati, OH USA

Crack Growth-Based Predictive Methodology for the Maintenance of the Structural Integrity of Repaired and Nonrepaired Aging Engine Stationary Components *Final Report*

Barron, Michael L., General Electric Co., USA; Apr. 1999; 105p; In English

Contract(s)/Grant(s): DTFA03-94-C-00066

Report No.(s): AD-A365643; DOT/FAA/AR-97/88; No Copyright; Avail: CASI; A02, Microfiche; A06, Hardcopy

This report contains the description and results of work conducted by General Electric Aircraft Engines (GEAE) between October 1994 and April 1997 under the Federal Aviation Administration (FAA) contract to study aging engine issues relative to stationary components. Specifically, the FAA's goal was to develop "Crack Growth-Based Predictive Methodologies for the Maintenance of the Structural Integrity of Repaired and Nonrepaired Aging Engine Stationary Components." GEAE's project in support of this goal was to study specific components, combustion casings, and compressor rear frames in service on older GEAE engines to determine if periodic inspections are warranted and to develop the tools necessary to conduct effective inspections should the data support a proactive need. The project was originally scheduled to cover a 5-year period but was prematurely curtailed due to funding priorities. A detail description of the planned work scope along with results for that portion of the work that was completed are reported herein.

DTIC

Aircraft Engines; Crack Propagation; Aging (Metallurgy); Structural Failure; Engine Parts

19990079371 NASA Lewis Research Center, Cleveland, OH USA

Calculation of Tip Clearance Effects in a Transonic Compressor Rotor

Chima, R. V., NASA Lewis Research Center, USA; Journal of Turbomachinery; Jan. 1998; Volume 120, pp. 131-140; In English; Copyright Waived (NASA); Avail: CASI; A02, Hardcopy; A01, Microfiche

The flow through the tip clearance region of a transonic compressor rotor (NASA rotor 37) was computed and compared to aerodynamic probe and laser anemometer data. Tip clearance effects were modeled both by gridding the clearance gap and by using a simple periodicity model across the ungridded gap. The simple model was run with both the full gap height, and with half the gap height to simulate a vena-contracta effect. Comparisons between computed and measured performance maps and downstream profiles were used to validate the models and to assess the effects of gap height on the simple clearance model. Recommendations were made concerning the use of the simple clearance model. Detailed comparisons were made between the gridded clearance gap solution and the laser anemometer data near the tip at two operating points. The computed results agreed fairly well with the data but overpredicted the extent of the casing separation and underpredicted the wake decay rate. The computations were then used to describe the interaction of the tip vortex, the passage shock, and the casing boundary layer.

Author

Computation; Transonic Compressors; Rotors; Flow Characteristics; Computerized Simulation

19990079372 NASA Lewis Research Center, Cleveland, OH USA

The Applicability of Jet-Shear-Layer Mixing and Effervescent Atomization for Low-NO(x) Combustors

Colantonio, R. O., NASA Lewis Research Center, USA; Journal of Engineering for Gas Turbines and Power; Jan. 1998; Volume 120, pp. 17-23; In English; Copyright Waived (NASA); Avail: CASI; A02, Hardcopy; A01, Microfiche

An investigation has been conducted to develop appropriate technologies for a low-NO(x), liquid-fueled combustor. The combustor incorporates an effervescent atomizer used to inject fuel into a premixing duct. Only a fraction of the combustion air is used in the premixing process. This fuel-rich mixture is introduced into the remaining combustion air by a rapid jet-shear-layer mixing process involving radial fuel-air jets impinging on axial air jets in the primary combustion zone. Computational modeling was used as a tool to facilitate a parametric analysis appropriate to the design of an optimum low-NO(x) combustor. A number of combustor configurations were studied to assess the key combustor technologies and to validate the three-dimensional modeling code. The results from the experimental testing and computational analysis indicate a low-NO(x) potential for the jet-shear-layer combustor. Key features found to affect NOx emissions are the primary combustion zone fuel-air ratio, the number of axial and radial jets, the aspect ratio and radial location of the axial air jets, and the radial jet inlet hole diameter. Each of these key parameters exhibits a low-NO(x) point from which an optimized combustor was developed. Also demonstrated was the feasibility of utilizing an effervescent atomizer for combustor application. Further developments in the jet-shear-layer mixing scheme and effervescent atomizer design promise even lower NO(x) with high combustion efficiency.

Author

Air Jets; Combustion Efficiency; Research; Procedures; Nitrogen Oxides; Liquid Fuels; Jet Mixing Flow; Analysis (Mathematics)

19990079744 National Aerospace Lab., Tokyo Japan

Spray and Combustion Characteristics of a Liquid-Fueled Ramjet Combustor

Sasaki, M.; Takahashi, M.; Sakamoto, H.; Kumakawa, A.; Yatsuyanagi, N.; Jul. 1998; 26p; In Japanese; In English; Portions of this document are not fully legible

Report No.(s): PB99-164881; NAL/TR-1349T; Copyright; Avail: National Technical Information Service (NTIS), Microfiche

Spray characteristics and combustion characteristics of a liquid-fueled ramjet combustor were experimentally investigated. A liquid fuel was injected transversely into a subsonic hot vitiation air-stream. The penetrations of the liquid jet under hot airflow conditions were larger than those calculated by the empirical equation obtained under room-temperature airflow conditions. A V-shaped gutter was attached to the center of the combustor for flame holding. Two different arrangements of the gutter and fuel injector were tested. In one of them, the fuel was injected perpendicular to the gutter axis, and in the other, the fuel was injected parallel to the axis. In the case of perpendicular fuel injection, a region with a temperature higher than 1500K was observed at the center of the combustor; this region was long and narrow in the direction of fuel injection. The high temperature region reached the bottom wall due to involvement of the fuel in the wake region of a fuel injector. In the case of parallel injection, the high temperature region covered almost the whole cross section of the combustor except in the vicinity of the bottom wall, and the measured combustion efficiencies were higher than those in the case of the perpendicular fuel injection.

NTIS

Spray Characteristics; Liquid Fuels; Ramjet Engines; Combustion Chambers

08

AIRCRAFT STABILITY AND CONTROL

Includes aircraft handling qualities; piloting; flight controls; and autopilots.

19990071177 Aerotech Engineering and Research, Lawrence, KS USA

Prediction of Antisymmetric Buffet Loads on Horizontal Stabilizers in Massively Separated Flows, Phase 2 Final Report

Farokhi, S.; Mirsafian, S.; Sherwood, T.; Ewing, M.; May 1999; 154p; In English

Contract(s)/Grant(s): DTRS-57-95-C-00091

Report No.(s): PB99-154478; DOT/FAA/AR-99/27; No Copyright; Avail: CASI; A02, Microfiche; A08, Hardcopy

The Federal Aviation Administration (FAA) has a continuing program to collect data and develop predictive methods for aircraft flight loads. Some of the most severe and potentially catastrophic flight loads are produced by separated flows. Structural response to the aerodynamic excitation produced by separated flow is defined as buffeting.

NTIS

Buffeting; Stabilizers (Fluid Dynamics); Wind Tunnel Tests; Prediction Analysis Techniques; Separated Flow; Aerodynamic Loads; Antisymmetry

19990071215 NASA Langley Research Center, Hampton, VA USA

Advanced Aerodynamic Control Effectors

Wood, Richard M., NASA Langley Research Center, USA; 1999; 14p; In English; 1999 World Aviation Congress, 19-21 Oct. 1999, San Francisco, CA, USA; Sponsored by Society for Automotive Engineers, Inc.

Report No.(s): SAE-1999-01-5619; Copyright; Avail: Issuing Activity, Hardcopy

A 1990 research program that focused on the development of advanced aerodynamic control effectors (MCE) for military aircraft has been reviewed and summarized. Data are presented for advanced planform, flow control, and surface contouring technologies. The data show significant increases in lift, reductions in drag, and increased control power, compared to typical aerodynamic designs. The results presented also highlighted the importance of planform selection in the design of a control effector suite. Planform data showed that dramatic increases in lift (greater than 25%) can be achieved with multiple wings and a sawtooth forebody. Passive porosity and micro drag generator control effector data showed control power levels exceeding that available from typical effectors (moving surfaces). Application of an advanced planform to a tailless concept showed benefits of similar magnitude as those observed in the generic studies.

Author

Research; Aerodynamics; Product Development; Control Boards

19990076724 Georgia Inst. of Tech., School of Aerospace Engineering, Atlanta, GA USA

F-15 Tail Buffet Alleviation: A Smart Structure Approach

Hanagud, S.; Dec. 02, 1998; 119p; In English

Contract(s)/Grant(s): F33615-96-C-3204

Report No.(s): AD-A365704; GIT-E-16-N32; No Copyright; Avail: CASI; A06, Hardcopy; A02, Microfiche

In high performance twin-tail aircraft fighter aircraft (HPTTA), tail buffet was first noticed through its destructive effects of induced fatigue cracks in the F-15 aircraft. The fatigue cracks were noticed shortly (less than six months) after the F-15 was placed in service and many high angles of attack maneuvers were executed. After repeated temporary structural fixes, a thorough investigation of the conditions leading to the crack confirmed that tail buffet is the cause of these effects. There are two significant effects of the buffet induced tail vibrations. These vibrations can restrict the flight maneuvering capability by restricting the angles of attack and speeds at which maneuvers such as the wind-up and wind-down turns can be executed. The second effect is caused by fatigue cracks and the resulting corrosion due to moisture absorption through the cracks. The objective of this work is to describe the results of our work in the area of buffet alleviation by the use of piezoceramic stack actuator assemblies.

DTIC

F-15 Aircraft; Smart Structures; Smart Materials; Aircraft Structures; Piezoelectric Ceramics

19990077741 Naval Postgraduate School, Monterey, CA USA

Miniaturization of a Microcontroller for the Tactile Situational Awareness System

Wood, Terrence L.; Jun. 1999; 206p; In English

Report No.(s): AD-A365613; No Copyright; Avail: CASI; A10, Hardcopy; A03, Microfiche

Loss of Situational Awareness (SA) is a leading cause of pilot related mishaps, resulting in numerous fatalities and costing the Department of Defense an estimated \$300 million annually in destroyed aircraft. Loss of SA can occur when a pilot incorrectly perceives the attitude, altitude, or motion of their aircraft. As one solution to the SA problem, the Naval Aerospace Medical Research Laboratory has developed the Tactile Situational Awareness System (TSAS). The primary objective of TSAS is to enhance pilot performance and reduce SA related aircrew/aircraft losses by providing continuous non-visual information using the normally underutilized sensory channel of touch. Using vibrotactile stimulators, TSAS applies information taken from the aircraft's instruments to the pilot's torso. Prototypes have been built and flight tested with positive results. However, the current implementation of TSAS is a research system that is not compatible with the crowded cockpits of modern aircraft. This thesis presents a design of a miniature microcontroller for the TSAS that is compatible with tactical environments. This new microcontroller system incorporates the functionality of the research TSAS into a palm sized device.

DTIC

Human Factors Engineering; Miniaturization; Estimating; Losses; Medical Science; Pilot Performance

19990078583 NASA Dryden Flight Research Center, Edwards, CA USA

Updated Results of Deterministic Reconfigurable Control Design for the X-33 Vehicle

Cotting, M. Christopher, Lockheed Martin Corp., USA; Burken, John J., NASA Dryden Flight Research Center, USA; [1999]; 7p; In English

Report No.(s): AIAA Paper 99-2934; Copyright; Avail: Issuing Activity, Hardcopy

In the event of a control surface failure, the purpose of a reconfigurable control system is to redistribute the control effort among the remaining working surfaces such that satisfactory stability and performance are retained. An Off-line Nonlinear General Constrained Optimization approach was used for the reconfigurable X-33 control design method. Three examples of failure are shown using a high fidelity 6 DOF simulation (case 1: ascent with a left body flap jammed at 25 deg.; case 2: entry with a right inboard elevon jam at 25 deg. and case 3: landing (TAEM) (Terminal Area Energy Management) with a left rudder jam at -30 deg.) Failure comparisons between responses with the nominal controller and reconfigurable controllers show the benefits of reconfiguration. Single jam aerosurface failures were considered, and failure detection and identification is considered accomplished in the actuator controller. The X-33 flight control system will incorporate reconfigurable flight control in the baseline system.

Author

Flight Control; X-33 Reusable Launch Vehicle; Aircraft Configurations; Control Configured Vehicles; Control Systems Design; Actuators; Controllers

19990079392 General Accounting Office, Resources, Community and Economic Development Div., Washington, DC USA
Aviation Safety: Research Supports Limited Use of Personal Computer Aviation Training Devices for Pilots
Jul. 1999; 47p; In English

Report No.(s): AD-A366143; GAO/RCED-99-143; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

You asked us to (1) describe the process and information FAA used in deciding to approve the use of personal computer devices for 10 hours of instrument training and (2) discuss what is known about the training effectiveness of these devices and their long term impact on a pilot's ability to fly safely. to respond to these objectives, we interviewed federal officials and others familiar with FAA's decision and reviewed FAA's supporting documentation; conducted a comprehensive literature search on the use of these and similar computer based devices, on instrument training, and on general aviation safety; reviewed about 700 studies and articles; analyzed and summarized the most relevant data based literature; interviewed government, academic, and private sector flight instruction experts on the use of the devices; and identified other issues related to the devices' potential impacts on aviation safety.

DTIC

Aircraft Safety; Flight Safety; Training Devices; Pilot Training; Flight Simulators

19990080966 NASA Langley Research Center, Hampton, VA USA

Modified Dynamic Inversion to Control Large Flexible Aircraft: What's Going on?

Gregory, Irene M., NASA Langley Research Center, USA; 1999; 12p; In English; Guidance, Navigation and Control, 9-11 Aug. 1999, Portland, OR, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA

Report No.(s): AIAA Paper 99-3998; Copyright; Avail: Issuing Activity, Hardcopy

High performance aircraft of the future will be designed lighter, more maneuverable, and operate over an ever expanding flight envelope. One of the largest differences from the flight control perspective between current and future advanced aircraft is elasticity. Over the last decade, dynamic inversion methodology has gained considerable popularity in application to highly maneuverable fighter aircraft, which were treated as rigid vehicles. This paper explores dynamic inversion application to an advanced highly flexible aircraft. An initial application has been made to a large flexible supersonic aircraft. In the course of controller design for this advanced vehicle, modifications were made to the standard dynamic inversion methodology. The results of this application were deemed rather promising. An analytical study has been undertaken to better understand the nature of the made modifications and to determine its general applicability. This paper presents the results of this initial analytical look at the modifications to dynamic inversion to control large flexible aircraft.

Author

Flight Control; Aircraft Control; Highly Maneuverable Aircraft; Fighter Aircraft; Supersonic Aircraft

19990081065 Kyushu Univ., Faculty of Engineering, Fukuoka, Japan

Active Control of Low Frequency Blade Flutter by Acoustic Excitation

Toshimitsu, Kazu; Otsuka, Takeshi; Maruo, Hiroko; Namba, Masanobu; Technology Reports of Kyushu University; March 1999; ISSN 0023-2718; Volume 72, No. 2, pp. 109-114; In Japanese; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

The paper presents a theoretical analysis and an experimental study of blade flutter suppression by means of active acoustic excitation. In the theoretical analysis, a linearized mathematical method to calculate the aerodynamic force and work on an oscillating airfoil interacting with sound waves generated from a loud-speaker mounted at a wall surface of a wind tunnel is formulated. Dependence of the suppression effect on the location, width of the actuator surface and the phase difference between the blade and actuator surface oscillations are investigated. Both theoretical and experimental results show that the actuator

surface oscillation most effectively suppresses a coupled bending-torsional oscillation of the blade when the center of the loud-speaker diaphragm is placed a quarter blade chord downstream from the leading edge of the blade. Furthermore a 12.5% increase in a critical flutter velocity could be attained by the active control system.

Author

Active Control; Low Frequencies; Flutter; Acoustic Excitation; Vibration Damping; Unsteady Flow; Oscillations; Sound Generators

19990081120 Kyushu Univ., Faculty of Engineering, Fukuoka, Japan

Active Control of A Low Frequency Cascade Flutter by Acoustic Excitation

Toshimitsu, Kazu; Yamagata, Akihiro; Nagai, Kenichiro; Namba, Masanobu; Technology Reports of Kyushu University; March 1999; ISSN 0023-2718; Volume 72, No. 2, pp. 115-121; In Japanese; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

The paper presents theoretical and experimental studies to investigate how one can control and suppress cascade flutter through an acoustic excitation. The model considered herein is a three-dimensional linear cascade of flat plates oscillating in a low speed flow between parallel walls. An actuator consisting of loudspeakers is set on a wind tunnel wall at the blades tip side, and generates sound waves with the same frequency of the blade vibration. To determine the most effective suppressive condition, the dependence of the suppression effect on the width, location of actuator surface and phase difference between the blades and actuator is investigated. Experimental results show that the loudspeakers can work most effectively when the centerline of the actuator surface is located at three-quarters chord point from the leading edge of blades. Furthermore an 8% increase in a critical flutter velocity of 5.3 Hz coupled bending-torsion flutter is obtained. Some modified numerical results are qualitatively agree with the experimental results.

Author

Active Control; Cascade Flow; Flutter; Acoustic Excitation; Sound Generators; Loudspeakers

09

RESEARCH AND SUPPORT FACILITIES (AIR)

Includes airports, hangars and runways; aircraft repair and overhaul facilities; wind tunnels; shock tubes; and aircraft engine test stands.

19990071195 NASA Glenn Research Center, Cleveland, OH USA

NASA Glenn 1-by 1-Foot Supersonic Wind Tunnel User Manual

Seabloom, Kirk D., NASA Glenn Research Center, USA; Soeder, Ronald H., NASA Glenn Research Center, USA; Stark, David E., NASA Glenn Research Center, USA; Leone, John F. X., NASA Glenn Research Center, USA; Henry, Michael W., NYMA, Inc., USA; April 1999; 32p; In English

Contract(s)/Grant(s): RTOP 523-91-13

Report No.(s): NASA/TM-1999-208478; NAS 1.15:208478; E-11251; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This manual describes the NASA Glenn Research Center's 1 - by 1 -Foot Supersonic Wind Tunnel and provides information for customers who wish to conduct experiments in this facility. Tunnel performance envelopes of total pressure, total temperature, and dynamic pressure as a function of test section Mach number are presented. For each Mach number, maps are presented of Reynolds number per foot as a function of the total air temperature at the test section inlet for constant total air pressure at the inlet. General support systems-such as the service air, combustion air, altitude exhaust system, auxiliary bleed system, model hydraulic system, schlieren system, model pressure-sensitive paint, and laser sheet system are discussed. In addition, instrumentation and data processing, acquisition systems are described, pretest meeting formats and schedules are outlined, and customer responsibilities and personnel safety are addressed.

Author

Mach Number; Reynolds Number; Supersonic Wind Tunnels; Supersonic Flow; Test Chambers; Data Acquisition; Manuals

19990073060 Communications Research Lab., Tokyo, Japan

Anechoic Chamber for VHF and UHF Bands

Morikawa, Takao, Communications Research Lab., Japan; Sugiura, Akira, Communications Research Lab., Japan; Harima, Katsushige, Communications Research Lab., Japan; Masuzawa, Hiroshi, Communications Research Lab., Japan; Review of the Communications Research Laboratory; Jun. 1995; ISSN 0914-9279; Volume 41, No. 2, pp. 109-116; In Japanese; No Copyright;

Avail: Issuing Activity, Hardcopy, Microfiche

Built in 1969, the anechoic chamber of CRL has been used to the fullest by researchers in many fields such as EMI, EMC, antenna design, standard of electric field intensity, and type approval testing. In particular, in the early days of space development in Japan, many satellite-born antennas were developed in this anechoic chamber. However, a quarter of a century has passed since its construction and deteriorated performance due to superannuation sometimes caused difficulties in experiments conducted in the chamber. In 1993, CRL constructed a Measuring Facility for Radio Research (MFRR) and the anechoic chamber for VHF-UHF bands was remodeled as one of the sub-facilities of MFRR. The remodeling work included full replacement of the electromagnetic shielding, absorbers and measurement system. Since the remodeled anechoic chamber is being used not only for EMI tests but also for other purposes, a full-anechoic chamber has been adopted. In addition the antenna positioner can be housed under the floor absorbers to create an ideal free space. The chamber has been designed for the frequency range between 30 MHz and 10 GHz. After the remodeling work, the performance of the chamber is greatly improved. The average shielding factor is better than 85 dB for all frequency ranges and the unwanted reflection characteristic is -30 dB for frequencies above 1 GHz. This paper summarizes the remodeling work, and the specifications and performance of the remodeled anechoic chamber.

Author

Anechoic Chambers; Replacing; Construction; Military Air Facilities; Ultrahigh Frequencies

19990073061 Communications Research Lab., Tokyo, Japan

An Anechoic Chamber for SHF and EHF Bands

Fujino, Yoshiyuki, Communications Research Lab., Japan; Fujita, Masaharu, Communications Research Lab., Japan; Review of the Communications Research Laboratory; Jun. 1995; ISSN 0914-9279; Volume 41, No. 2, pp. 117-123; In Japanese; No Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

A small scale radio anechoic chamber was constructed for antenna measurement and/or EMC measurement in the SHF and EHF bands. This paper summarizes special features of the anechoic chamber, and gives detailed explanations of the chamber, measurement system, and measurement software.

Author

Anechoic Chambers; Extremely High Frequencies; Superhigh Frequencies; Construction; Scale (Ratio)

19990073063 Communications Research Lab., Tokyo, Japan

Open-Field Test Site

Gyoda, Koichi, Communications Research Lab., Japan; Shinozuka, Takashi, Communications Research Lab., Japan; Review of the Communications Research Laboratory; Jun. 1995; ISSN 0914-9279; Volume 41, No. 2, pp. 139-150; In Japanese; No Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

An open-field test site with measurement equipment, a turn table, antenna positions and measurement auxiliary equipment was remodeled at the CRL north-site. This paper introduces the configuration, specifications and characteristics of this new open-field test site. Measured 3-m and 10-m site attenuations are in good agreement with theoretical values, and this means that this site is suitable for using 3-m and 10-m method EMI/EMC measurements. This site is expected to be effective for antenna measurement, antenna calibration, and studies on EMI/EMC measurement methods.

Author

Specifications; Measuring Instruments; Manufacturing; Military Air Facilities

19990076733 Federal Aviation Administration, Technical Center, Atlantic City, NJ USA

Video Landing Parameter Survey-Washington National Airport Final Report

Barnes, Terence, Federal Aviation Administration, USA; DeFiore, Thomas, Federal Aviation Administration, USA; Micklos, Richard, Federal Aviation Administration, USA; Jun. 1999; 42p; In English

Contract(s)/Grant(s): DTFA03-94-Z-0029

Report No.(s): AD-A365692; DOT/FAA/AR-97/106; DOT/FAA/AR-97/106; No Copyright; Avail: CASI; A01, Microfiche; A03, Hardcopy

The Federal Aviation Administration William J. Hughes Technical Center is conducting a series of video landing parameter surveys at high-capacity commercial airports to acquire a better understanding of typical contact conditions for a wide variety of aircraft and airports as they relate to current aircraft design criteria and practices. This was the second in a ongoing series of parameter landing surveys and was conducted at Washington National Airport in June 1995. Four video cameras were temporarily installed along the east side of runway 36. Video images of 532 transport, (525 narrow-body jets and 7 commuter jets) were captured, analyzed, and the results presented herein. Landing parameters presented include sink rate; approach speed; touchdown pitch, roll, and yaw angles; off-center distance; and the touchdown distance from the runway threshold measured along the runway

center line. Wind and weather conditions were also recorded and landing weights were available for most landings. Since this program is only concerned with the overall statistical usage information, all data were processed and are presented without regard to the airline or the flight number.

DTIC

Aircraft Design; Aircraft Landing; Television Cameras; Touchdown; Airports

19990087086 Institute for Human Factors TNO, Soesterberg, Netherlands

Performance Tests of the Upgrade of the Leopard 2 Driving Simulator *Interim Report Prestatietests van de Verbetering van de Leopard 2 Rijsimulator*

Padmos, P., Institute for Human Factors TNO, Netherlands; May 12, 1999; 21p; In English

Contract(s)/Grant(s): A96/KL/345; TNO Proj. 730.3

Report No.(s): TD99-0043; TM-99-A037; Copyright; Avail: Issuing Activity, Hardcopy

On the Leopard 2 driving simulator, in use for training by the Royal Netherlands Army, an upgrade took place recently. This upgrade consisted of the following: 1. installing a Bird's Eye View system (BEV), enabling the instructor to exactly monitor the vehicle's position in its environment; 2. installing a Performance Measurement and Feedback system (PMF), which automatically measures and reports the driving performance of a trainee, and compares this with performance of other trainees; and 3. improving the SPRITE system for vehicle-terrain interaction. Performance tests of these systems were conducted, based on system specifications designed by the TNO Human Factors Research Institute. These tests revealed many items which were not according to the specifications, or for which improvement was wanted. Presently, most of these errors have been repaired by the manufacturer. A few other minor errors or improvements wanted, which are not critical for the system's performance, were neglected. Several points of attention remain, concerning not only the BEV and PMF systems but also the Record Replay system and the vehicle dynamics.

Author

Performance Tests; Training Simulators; Human Factors Engineering

10

ASTRONAUTICS

Includes astronautics (general); astrodynamics; ground support systems and facilities (space); launch vehicles and space vehicles; space transportation; space communications, spacecraft communications, command and tracking; spacecraft design, testing and performance; spacecraft instrumentation; and spacecraft propulsion and power.

19990087367 NASA Langley Research Center, Hampton, VA USA

Entry Trajectory Issues for the Stardust Sample Return Capsule

Desai, Prasun N., NASA Langley Research Center, USA; Mitcheltree, Robert A., NASA Langley Research Center, USA; Cheatwood, F. McNeil, NASA Langley Research Center, USA; 1999; 12p; In English; Atmospheric Reentry Vehicles and Systems, 16-18 Mar. 1999, Arcachon, France; Copyright; Avail: Issuing Activity, Hardcopy

The Stardust mission was successfully launched on February 7, 1999. It will be the first mission to return samples from a comet. The sample return capsule, which is passively controlled during the fastest Earth entry ever, will land by parachute in Utah. The present study describes the analysis of the entry, descent, and landing of the returning sample capsule utilizing the final, launch configuration capsule mass properties. The effects of two aerodynamic instabilities are revealed (one in the high altitude free molecular regime and the other in the transonic/subsonic flow regime). These instabilities could lead to unacceptably large excursions in the angle-of-attack near peak heating and main parachute deployment, respectively. To reduce the excursions resulting from the high altitude instability, the entry spin rate of the capsule is increased. To stabilize the excursions from the transonic/subsonic instability, a drogue chute with deployment triggered by a gravity-switch and timer is added prior to main parachute deployment. A Monte Carlo dispersion analysis of the modified entry (from which the impact of off-nominal conditions during the entry is ascertained) predicts that the capsule attitude excursions near peak heating and drogue chute deployment are within Stardust mission limits. Additionally, the size of the resulting 3-sigma landing ellipse is 60.8 km in downrange by 19.9 km in crossrange, which is within the Utah Test and Training Range boundaries.

Author

Atmospheric Entry; Monte Carlo Method; Stardust Mission; Atmospheric Entry Simulation; Aeromaneuvering; Aerodynamic Heating

19990078592 NASA Marshall Space Flight Center, Huntsville, AL USA

Collaborative Analysis Tool for Thermal Protection Systems for Single Stage to Orbit Launch Vehicles

Alexander, Reginald Andrew, NASA Marshall Space Flight Center, USA; Stanley, Thomas Troy, International Space Systems, Inc., USA; 1999; In English; Atmospheric Reentry Vehicles and Systems, Mar. 1999, Arcachon, France; Copyright; Avail: Issuing Activity; Abstract Only, Hardcopy, Microfiche

Presented is a design tool and process that connects several disciplines which are needed in the complex and integrated design of high performance reusable single stage to orbit (SSTO) vehicles. Every system is linked to every other system and in the case of SSTO vehicles with air breathing propulsion, which is currently being studied by the National Aeronautics and Space Administration (NASA); the thermal protection system (TPS) is linked directly to almost every major system. The propulsion system pushes the vehicle to velocities on the order of 15 times the speed of sound in the atmosphere before pulling up to go to orbit which results high temperatures on the external surfaces of the vehicle. Thermal protection systems to maintain the structural integrity of the vehicle must be able to mitigate the heat transfer to the structure and be lightweight. Herein lies the interdependency, in that as the vehicle's speed increases, the TPS requirements are increased, and as TPS masses increase the effect on the propulsion system and all other systems is compounded. to adequately determine insulation masses for a vehicle such as the one described above, the aeroheating loads must be calculated and the TPS thicknesses must be calculated for the entire vehicle. to accomplish this an ascent or reentry trajectory is obtained using the computer code Program to Optimize Simulated Trajectories (POST). The trajectory is then used to calculate the convective heat rates on several locations on the vehicles using the Miniature Version of the JA70 Aerodynamic Heating Computer Program (MINIVER). Once the heat rates are defined for each body point on the vehicle, then insulation thickness that are required to maintain the vehicle within structural limits are calculated using Systems Improved Numerical Differencing Analyzer (SINDA) models. If the TPS masses are too heavy for the performance of the vehicle the process may be repeated altering the trajectory or some other input to reduce the TPS mass.

Author

Convective Heat Transfer; Launch Vehicles; Single Stage to Orbit Vehicles; Thermal Analysis; Thermal Protection; Aerodynamic Heating

19990079742 National Aerospace Lab., Tokyo Japan

Two Parallel Streams Model for Drag Reduction of Separated Booster

Nomizo, K.; Ishida, K.; Sekine, H.; Tani, T.; Noda, J.; Dec. 1998; 26p; In Japanese; Portions of this document are not fully legible Report No.(s): PB99-164964; NAL-TR-1367; Copyright; Avail: National Technical Information Service (NTIS), Hardcopy

In wake flow, remarkable drag reduction occurs non-uniform supersonic flow. This phenomenon is important to avoid collision from behind by separated booster. The most simple model for such flow is a set of two parallel flows with different velocities. Analysis for shock wave transfer between these streams gives a reasonable explanation for the results of experiments in NAI.

NTIS

Parallel Flow; Drag Reduction; Booster Rocket Engines; Separated Flow; Supersonic Drag

19990084057 NASA Marshall Space Flight Center, Huntsville, AL USA

Sliding Mode Control of the X-33 Vehicle in Launch Mode

Shtessel, Yuri, Alabama Univ., USA; Jackson, Mark, NASA Marshall Space Flight Center, USA; Hall, Charles, NASA Marshall Space Flight Center, USA; Krupp, Don, NASA Marshall Space Flight Center, USA; Hendrix, N. Douglas, NASA Marshall Space Flight Center, USA; 1998; 1p; In English, 24-26 Jun. 1998, Philadelphia, PA, USA; Copyright; Avail: Issuing Activity, Hardcopy; Abstract Only

The "nested" structure of the control system for the X33 vehicle in launch mode is developed. Employing backstopping concepts, the outer loop (guidance) and the Inner loop (rates) continuous sliding mode controllers are designed. Simulations of the 3-DOF model of the X33 launch vehicle showed an accurate, robust, de-coupled tracking performance.

Author

Launching; Simulation; X-33 Reusable Launch Vehicle; Flight Control; In-Flight Simulation; Mathematical Models

19990076703 Lockheed Martin Corp., Operational Control Center, Edwards AFB, CA USA

X-33 Telemetry Best Source Selection, Processing, Display, and Simulation Model Comparison

Burkes, Darryl A., Lockheed Martin Corp., USA; 1998; 1p; In English; Telemetry, 26-29 Oct. 1998, San Diego, CA, USA Contract(s)/Grant(s): NCC8-115; Copyright; Avail: Issuing Activity, Hardcopy; Abstract Only

The X-33 program requires the use of multiple telemetry ground stations to cover the launch, ascent, transition, descent, and approach phases for the flights from Edwards AFB to landings at Dugway Proving Grounds, UT and Malmstrom AFB, MT. This

paper will discuss the X-33 telemetry requirements and design, including information on fixed and mobile telemetry systems, best source selection, and support for Range Safety Officers. A best source selection system will be utilized to automatically determine the best source based on the frame synchronization status of the incoming telemetry streams. These systems will be used to select the best source at the landing sites and at NASA Dryden Flight Research Center to determine the overall best source between the launch site, intermediate sites, and landing site sources. The best source at the landing sites will be decommutated to display critical flight safety parameters for the Range Safety Officers. The overall best source will be sent to the Lockheed Martin's Operational Control Center at Edwards AFB for performance monitoring by X-33 program personnel and for monitoring of critical flight safety parameters by the primary Range Safety Officer. The real-time telemetry data (received signal strength, etc.) from each of the primary ground stations will also be compared during each mission with simulation data generated using the Dynamic Ground Station Analysis software program. An overall assessment of the accuracy of the model will occur after each mission. Acknowledgment: The work described in this paper was NASA supported through cooperative agreement NCC8-115 with Lockheed Martin Skunk Works.

Author

Flight Safety; Ground Stations; X-33 Reusable Launch Vehicle; Telemetry; Requirements; Functional Design Specifications

19990079773 NASA Goddard Space Flight Center, Greenbelt, MD USA

Nano-Satellite Avionics

Culver, Harry, NASA Goddard Space Flight Center, USA; 1999; 1p; In English; MNT99, 11-15 Apr. 1999, Pasadena, CA, USA; Copyright; Avail: Issuing Activity, Hardcopy; Abstract Only

Abstract NASA's Goddard Space Flight Center (GSFC) is currently developing a new class of satellites called the nano-satellite (nano-sat). A major objective of this development effort is to provide the technology required to enable a constellation of tens to hundreds of nano-satellites to make both remote and in-situ measurements from space. The Nano-sat will be a spacecraft weighing a maximum of 10 kg, including the propellant mass, and producing at least 5 Watts of power to operate the spacecraft. The electronics are required to survive a total radiation dose rate of 100 krads for a mission lifetime of two years. There are many unique challenges that must be met in order to develop the avionics for such a spacecraft. The first challenge is to develop an architecture that will operate on the allotted 5 Watts and meet the diverging requirements of multiple missions. This architecture will need to incorporate a multitude of new advanced microelectronic technologies. The microelectronics developed must be a modular and scalable packaging of technology to solve the problem of developing a solution to both reduce cost and meet the requirements of various missions. This development will utilize the most cost effective approach, whether infusing commercially driven semiconductor devices into spacecraft applications or partnering with industry to design and develop low cost, low power, low mass, and high capacity data processing devices. This paper will discuss the nano-sat architecture and the major technologies that will be developed. The major technologies that will be covered include: (1) Light weight Low Power Electronics Packaging, (2) Radiation Hard/Tolerant, Low Power Processing Platforms, (3) High capacity Low Power Memory Systems (4) Radiation Hard reconfigurable field programmable gate array (rFPGA)

Author

Avionics; Technology Utilization; Artificial Satellites; Small Satellite Technology; Nanosatellites; Satellite Design; Spacecraft Instruments; Microelectronics; Astrionics

19990071658 Control Dynamics Co., Huntsville, AL USA

Performance Evaluation Gravity Probe B Design *Final Report, 25 Sep. - 5 Apr. 1996*

Francis, Ronnie, Control Dynamics Co., USA; Wells, Eugene M., Control Dynamics Co., USA; Apr. 05, 1996; 94p; In English Contract(s)/Grant(s): NAS8-40618

Report No.(s): NASA/CR-1999-209565; NAS 1.26:209565; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche

This final report documents the work done to develop a 6 degree-of-freedom simulation of the Lockheed Martin Gravity Probe B (GPB) Spacecraft. This simulation includes the effects of vehicle flexibility and propellant slosh. The simulation was used to investigate the control performance of the spacecraft when subjected to realistic on orbit disturbances.

Author

Gravity Probe B; Flight Simulation; Spacecraft Stability; Spacecraft Performance; Spacecraft Motion; Spacecraft Models

19990079861 Lockheed Martin Michoud Space Systems, New Orleans, LA USA

Dual Liquid Flyback Booster for the Space Shuttle

Blum, C., Lockheed Martin Michoud Space Systems, USA; Jones, Patti, Lockheed Martin Michoud Space Systems, USA; Meinders, B., Lockheed Martin Michoud Space Systems, USA; 1998 JANNAP Propulsion Meeting; Jul. 1998; Volume 1, pp. 185-195; In English; See also 19990079846

Contract(s)/Grant(s): NAS8-97259; No Copyright; Avail: Issuing Activity (CPIA, 10630 Little Patuxent Pkwy., Suite 202, Columbia, MD 21044-3200), Hardcopy, Microfiche

Liquid Flyback Boosters provide an opportunity to improve shuttle safety, increase performance, and reduce operating costs. The objective of the LFBB study is to establish the viability of a LFBB configuration to integrate into the shuttle vehicle and meet the goals of the Space Shuttle upgrades program. The design of a technically viable LFBB must integrate into the shuttle vehicle with acceptable impacts to the vehicle elements, i.e. orbiter and external tank and the shuttle operations infrastructure. The LFBB must also be capable of autonomous return to the launch site. The smooth integration of the LFBB into the space shuttle vehicle and the ability of the LFBB to fly back to the launch site are not mutually compatible capabilities. LFBB wing configurations optimized for ascent must also provide flight quality during the powered return back to the launch site. This paper will focus on the core booster design and ascent performance. A companion paper, "Conceptual Design for a Space Shuttle Liquid Flyback Booster" will focus on the flyback system design and performance. The LFBB study developed design and aerodynamic data to demonstrate the viability of a dual booster configuration to meet the shuttle upgrade goals, i.e. enhanced safety, improved performance and reduced operations costs.

Author

Booster Rocket Engines; Space Shuttle Boosters; Flight Characteristics; Cost Reduction; Aerodynamic Configurations

19990079863 Boeing North American, Inc., Reusable Space Systems, Downey, CA USA

Shuttle Liquid Fly Back Booster Configuration Options

Healy, Thomas J., Jr., Boeing North American, Inc., USA; 1998 JANNAF Propulsion Meeting; Jul. 1998; Volume 1, pp. 209-222; In English; See also 19990079846

Contract(s)/Grant(s): NAS8-97272; No Copyright; Avail: Issuing Activity (CPIA, 10630 Little Patuxent Pkwy., Suite 202, Columbia, MD 21044-3200), Hardcopy, Microfiche

This paper surveys the basic configuration options available to a Liquid Fly Back Booster (LFBB), integrated with the Space Shuttle system. The background of the development of the LFBB concept is given. The influence of the main booster engine (BME) installations and the fly back engine (FBE) installation on the aerodynamic configurations are also discussed. Limits on the LFBB configuration design space imposed by the existing Shuttle flight and ground elements are also described. The objective of the paper is to put the constraints and design space for an LFBB in perspective. The object of the work is to define LFBB configurations that significantly improve safety, operability, reliability and performance of the Shuttle system and dramatically lower operations costs.

Author (revised)

Space Shuttle Boosters; Surveys; Aerodynamic Configurations; Booster Rocket Engines

19990079866 Air Force Research Lab., Wright-Patterson AFB, OH USA

Maximizing Propulsion Effectiveness Through Airbreathing and Rocket Synergies

Rogacki, J. R., Air Force Research Lab., USA; Vondrell, Jack U., Air Force Research Lab., USA; 1998 JANNAF Propulsion Meeting; Jul. 1998; Volume 1, pp. 241-243; In English; See also 19990079846; No Copyright; Avail: Issuing Activity (CPIA, 10630 Little Patuxent Pkwy., Suite 202, Columbia, MD 21044-3200), Hardcopy, Microfiche

A new organization was created recently to perform research and development for all propulsion technologies of interest to the USA Air Force and in concert with other services. It's the Propulsion Directorate, one of ten directorates making up the new Air Force Research Laboratory. Headquartered at Wright-Patterson Air Force Base in Ohio, it has a major component at Edwards Air Force Base in California. The directorate has over 600 government employees, an annual budget exceeding \$200 million, and facilities valued at almost two billion dollars. These range from turbine engine and rocket motor component facilities to stands capable of testing rockets producing ten million pounds of thrust. This new directorate is divided into four major technology divisions. These are the Propulsion Sciences and Advance Concepts Division, the Turbine Engine Division, the Rocket Propulsion Division and the Power Division. Created by a merger of the Aero Propulsion and Power Directorate with the Rocket Propulsion Directorate, the new organization has hundreds of active R&D programs in almost all forms of flight propulsion: turbine engines for both manned and uninhabited systems, ramjets and rockets for tactical air-launched missiles, scramjets for hypersonic systems, rocket motors for ICBM propulsion and orbit transfer, rocket engines for space launch vehicles, and advanced concepts to meet the diverse propulsion needs of satellites and other space systems. In addition we continue to develop aircraft power generation, distribution and storage for all flying Air Force systems.

Author

Air Breathing Engines; Research and Development; Propulsion; Ramjet Engines; Man Machine Systems; Launch Vehicles; Intercontinental Ballistic Missiles; Engine Parts; Air Launching

19990079868 NASA Marshall Space Flight Center, Huntsville, AL USA

Electrodynamic Tether Propulsion for Spacecraft and Upper Stages

Johnson, Les, NASA Marshall Space Flight Center, USA; Gilchrist, Brian, Michigan Univ., USA; Estes, Robert D., Smithsonian Astrophysical Observatory, USA; Lorenzini, Enrico, Smithsonian Astrophysical Observatory, USA; Martinez-Sanchez, Manuel, Massachusetts Inst. of Tech., USA; Sanmartin, Juan, Universidad Politecnica de Madrid, Spain; 1998 JANNAP Propulsion Meeting; Jul. 1998; Volume 1, pp. 253-262; In English; See also 19990079846; No Copyright; Avail: Issuing Activity (CPIA, 10630 Little Patuxent Pkwy., Suite 202, Columbia, MD 21044-3200), Hardcopy, Microfiche

Relatively short electrodynamic tethers can use solar power to "push" against a planetary magnetic field to achieve propulsion without the expenditure of propellant. The groundwork has been laid for this type of propulsion. Recent important milestones include retrieval of a tether in space (TSS-1, 1992), successful deployment of a 20-km-long tether in space (SEDS-1, 1993), and operation of an electrodynamic tether with tether current driven in both directions - power and thrust modes (PMG, 1993). The planned Propulsive Small Expendable Deployer System (ProSEDS) experiment will demonstrate electrodynamic tether thrust during its flight in early 2000. ProSEDS will use the flight-proven Small Expendable Deployer System (SEDS) to deploy a 5-km bare copper tether from a Delta 2 upper stage to achieve approx. 0.4 N drag thrust, thus de-orbiting the stage. The experiment will use a predominantly "bare" tether for current collection in lieu of the end-mass collector and insulated tether approach used on previous missions. The flight experiment is a precursor to utilization of the technology on the International Space Station (ISS) for re-boost and the electrodynamic tether upper stage demonstration mission which will be capable of orbit raising, lowering, and inclination changes - all using electrodynamic thrust. In addition, the use of this type of propulsion may be attractive for future missions to Jupiter.

Author

Tethering; Electrodynamics; Propulsion; Drag; Flight Characteristics

19990080067 Rockwell International Corp., Rocketdyne, Canoga Park, CA USA

Rocketdyne RBCC Concept Development

Ortwerth, P., Rockwell International Corp., USA; Ratekin, G., Rockwell International Corp., USA; Goldman, A., Rockwell International Corp., USA; Emanuel, M., Rockwell International Corp., USA; Brown, C., Rockwell International Corp., USA; Ketchum, A., Rockwell International Corp., USA; Horn, M., Rockwell International Corp., USA; 1997; In English; Propulsion, 1-2 Oct. 1997, Cleveland, OH, USA; Copyright; Avail: Issuing Activity; Abstract Only, Hardcopy, Microfiche

Rocketdyne is pursuing the conceptual design and development of a Rocket Based Combined Cycle (RBCC) engine for booster and SSTO, advanced reusable space transportation systems under the Advanced Reusable Transportation Technologies contract with NASA Marshall Space Flight Center. The Rocketdyne concept is a fixed geometry integrated rocket, ramjet, scramjet which is hydrogen fueled and uses hydrogen regenerative cooling. Vision vehicle integration studies have determined that scramjet operation to the range of Mach 10 to 12 has high payoff for low cost reusable space transportation. Rocketdyne is internally developing versions of the concept for other applications in high speed aircraft and missiles with hydrocarbon fuel systems. A subscale engine ground test program is underway for all modes of operation from takeoff to Mach 8. High altitude rocket tests will only be completed as part of the ground test program to validate high expansion ratio performance. A unique feature of the ground test series is the inclusion of dynamic trajectory simulation with real time Mach number, altitude, engine throttling, and RBCC mode changes in a specially modified freejet test facility at GASL. Preliminary cold flow air augmented rocket and all rocket test results have met program goals and have been used to integrate all modes of operation in a single combustor design with a fixed geometry inlet for design confirmation tests. A water cooled subscale engine is currently being fabricated for test during the early part of 1998.

Author

Engine Tests; Ground Tests; Rocket Engines; Ramjet Engines; Supersonic Combustion Ramjet Engines

19990081112 NASA Glenn Research Center, Cleveland, OH USA

Analysis of a New Rocket-Based Combined-Cycle Engine Concept at Low Speed

Yungster, S., NASA Glenn Research Center, USA; Trefny, C. J., NASA Glenn Research Center, USA; September 1999; 16p; In English; 35th; Joint Propulsion, 20-24 Jun. 1999, Los Angeles, CA, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA

Contract(s)/Grant(s): NCC3-542; RTOP 505-90-5K

Report No.(s): NASA/TM-1999-209393; NAS 1.15:209393; E-11824; AIAA Paper 99-2393; ICOMP-99-05; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

An analysis of the Independent Ramjet Stream (IRS) cycle is presented. The IRS cycle is a variation of the conventional ejector-Ramjet, and is used at low speed in a rocket-based combined-cycle (RBCC) propulsion system. In this new cycle, complete

mixing between the rocket and ramjet streams is not required, and a single rocket chamber can be used without a long mixing duct. Furthermore, this concept allows flexibility in controlling the thermal choke process. The resulting propulsion system is intended to be simpler, more robust, and lighter than an ejector-ramjet. The performance characteristics of the IRS cycle are analyzed for a new single-stage-to-orbit (SSTO) launch vehicle concept, known as "Trailblazer." The study is based on a quasi-one-dimensional model of the rocket and air streams at speeds ranging from lift-off to Mach 3. The numerical formulation is described in detail. A performance comparison between the IRS and ejector-ramjet cycles is also presented.

Author

Ramjet Engines; Rocket Engines; Single Stage to Orbit Vehicles; Propulsion System Performance; Propulsion System Configurations; Spacecraft Configurations

19990087368 Boeing Co., Seattle, WA USA

Space Shuttle Main Engine: Advanced Health Monitoring System

Singer, Chirs, NASA Marshall Space Flight Center, USA; 1999; 19p; In English; USA Shuttle Development, 28-30 Jul. 1999, Moffett Federal Airfield, CA, USA; No Copyright; Avail: Issuing Activity, Hardcopy

The main goal of the Space Shuttle Main Engine (SSME) Advanced Health Management system is to improve flight safety. To this end the new SSME has robust new components to improve the operating margin and operability. The features of the current SSME health monitoring system, include automated checkouts, closed loop redundant control system, catastrophic failure mitigation, fail operational/ fail-safe algorithms, and post flight data and inspection trend analysis. The features of the advanced health monitoring system include: a real time vibration monitor system, a linear engine model, and an optical plume anomaly detection system. Since vibration is a fundamental measure of SSME turbopump health, it stands to reason that monitoring the vibration, will give some idea of the health of the turbopumps. However, how is it possible to avoid shutdown, when it is not necessary. A sensor algorithm has been developed which has been exposed to over 400 test cases in order to evaluate the logic. The optical plume anomaly detection (OPAD) has been developed to be a sensitive monitor of engine wear, erosion, and breakage.

CASI

Fail-Safe Systems; Flight Safety; Space Shuttle Main Engine; System Failures; Turbine Pumps; Vibration

11

CHEMISTRY AND MATERIALS

Includes chemistry and materials (general); composite materials; inorganic and physical chemistry; metallic materials; nonmetallic materials; propellants and fuels; and materials processing.

19990075850 Delta Air Lines, Inc., Environmental Compliance, Atlanta, GA USA

Aerospace NESHAP Compliance: Planning and Lessons Learned at Delta Air Lines, Inc

Pearl, Ira G., Delta Air Lines, Inc., USA; Burke, Jack M., Radian International, LLC, USA; Hait, Mitchell J., Trinity Consultants Inc., USA; Third Aerospace Environmental Technology Conference; April 1999, pp. 20-37; In English; See also 19990075847; No Copyright; Avail: CASI; A03, Hardcopy; A06, Microfiche

Delta Air Lines' began its efforts to comply with the Aerospace NESHAP over two years before the effective date of the rule, with intensive efforts commencing upon issuance of the revised rule, approximately one year in advance of the scheduled compliance date. This paper discusses the processes used to develop, review, refine, and implement a Master Compliance Plan. In addition to outlining the planning and implementation processes used, this discussion will also focus on system requirements, such as material monitoring and record keeping, personnel training, and lessons learned during the implementation of the Master Plan.

Author

Civil Aviation; Commercial Aircraft; Management Information Systems; Records Management

19990080054 NASA Glenn Research Center, Cleveland, OH USA

SiC and Si₃N₄ Recession Due to SiO₂ Scale Volatility Under Combustor Conditions

Smialek, James L., NASA Glenn Research Center, USA; Robinson, Raymond C., DYNACS Engineering Co., Inc., USA; Opila, Elizabeth J., Cleveland State Univ., USA; Fox, Dennis S., NASA Glenn Research Center, USA; Jacobson, Nathan S., NASA Glenn Research Center, USA; July 1999; 10p; In English

Contract(s)/Grant(s): RTOP 537-04-23

Report No.(s): NASA/TP-1999-208696; E-11447; NAS 1.60:208696; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

Silicon carbide (SiC) and Si₃N₄ materials were tested in various turbine engine combustion environments chosen to represent either conventional fuel-lean or fuel-rich mixtures proposed for high-speed aircraft. Representative chemical vapor-deposited (CVD), sintered, and composite materials were evaluated by furnace and high-pressure burner rig exposures. Although protective SiO₂ scales formed in all cases, the evidence presented supports a model based on parabolic growth kinetics (i.e., parabolic growth moderated simultaneously by linear volatilization). The volatility rate is dependent on temperature, moisture content, system pressure, and gas velocity. The burner tests were thus used to map SiO₂ volatility (and SiC recession) over a range of temperatures, pressures, and velocities. The functional dependency of material recession (volatility) that emerged followed the form $A[\exp(-Q/RT)](P(\sup x)v(\sup y))$. These empirical relations were compared with rates predicted from the thermodynamics of volatile SiO and SiO_xH_y reaction products and a kinetic model of diffusion through a moving boundary layer. For typical combustion conditions, recession of 0.2 to 2 micrometers/hr is predicted at 1200 to 1400 C, far in excess of acceptable long-term limits.

Author

Silicon Carbides; Silicon Nitrides; Silicon Dioxide; Volatility; Turbine Engines; Combustion Chambers

12 ENGINEERING

Includes engineering (general); communications and radar; electronics and electrical engineering; fluid mechanics and heat transfer; instrumentation and photography; lasers and masers; mechanical engineering; quality assurance and reliability; and structural mechanics.

19990075901 Northrop Grumman Corp., Bethpage, NY USA

Environmentally Acceptable Hydraulic Oil Flush Solvent Cleaning Program for the Replacement of Freon, an Ozone Depleting Chemical

Weir, John, Northrop Grumman Corp., USA; Doria, Richard, Northrop Grumman Corp., USA; Sinowitz, Allen, Northrop Grumman Corp., USA; Third Aerospace Environmental Technology Conference; April 1999, pp. 620-634; In English; See also 19990075847; No Copyright; Avail: CASI; A03, Hardcopy; A06, Microfiche

Laboratory testing indicated that 3M's HFE 7100 and Petroferm's PFC 265-141 solvents can be used to replace Freon TF (CFC 113) for cleaning off hydraulic oil, MIL-H-83282 from the interior of E2C and F-14 aircraft surfaces. Hydraulic oil removal rates, as well as, material compatibility testing resulted in selecting PFC 265-141 solvent for oil removal followed by a final flush of HFE 7100 to assure the complete removal of the oil contaminated PFC 265-141 solvent. Testing indicated that 3M's HFE 71DE and Dupont's Vertrel SMT and Vertrel MCA were not compatible with MIL-L-81352 acrylic coatings used on the aforementioned production aircraft. The presentation reports the data generated during the test program and describes the methodology used to qualify the materials for this application. The methodology considered functional testing which included hydraulic oil removal rates, evaporation rate, and flash point considerations. Additionally, extensive material compatibility testing was accomplished on aircraft materials to assure the selected solvents would not damage aircraft coatings, sealant, part markings, wiring, electrical connectors, tube markings as well as high strength steel.

Author

Cleaning; Solvents; Silicon; Rubber; Compatibility; F-14 Aircraft; Aircraft Parts

19990079406 Communications Research Lab., Tokyo, Japan

Development of a High Efficiency Rectenna and its Application to a Stationary Flight Experiment of an Unmanned Airship

Fujino, Yoshiyuki, Communications Research Lab., Japan; Fujita, Masaharu, Communications Research Lab., Japan; Kaya, Nobuyuki, Communications Research Lab., Japan; Onda, Masahiko, Communications Research Lab., Japan; Tomita, Kazumasa, Communications Research Lab., Japan; Review of the Communications Research Laboratory; September 1998; ISSN 0914-9279; Volume 44, No. 3, pp. 139-160; In Japanese; Copyright; Avail: Issuing Activity, Hardcopy

The Energy Transmission to a High altitude long endurance airship Experiment (ETHER) was carried out in 1995 as cooperative research among the Communications Research Laboratory, Kobe University, Mechanical Engineering Laboratory, and Advanced Engineering Service, Co. Ltd. The Communications Research Laboratory developed a rectenna for microwave power reception for use on board the airship which was driven with electricity transmitted by microwaves. The rectenna was designed to be thin and lightweight using microstrip antennas and rectifying circuits suitable for airship applications. It was of dual polarization design to double the transmitting power and to receive the microwave power with no polarization mismatching loss. It consisted of 1,200 elements and its weight was 22.8 kg. The RF-DC conversion efficiency of a 20-element subarray was

81% at the maximum. The rectenna provided DC power of 3 kW to the airship, and the airship was flown continuously for about 3 minutes using the electricity.

Author

Rectennas; Airships; Pilotless Aircraft

19990071053 Rolls-Royce Ltd., Derby, UK

The Numerical Simulation and Experimental Validation of Ventilation Flow and Fire Events in a Trent Nacelle Fire Zone

Mullender, A. J., Rolls-Royce Ltd., UK; Coney, M. H., Rolls-Royce Ltd., UK; Horrocks, D. M., Loughborough Univ. of Technology, UK; McGuirk, J. J., Loughborough Univ. of Technology, UK; Binks, D., Cranfield Univ., UK; Li, G., Cranfield Univ., UK; Moss, J. B., Cranfield Univ., UK; Rubini, P. A., Cranfield Univ., UK; Stewart, C. D., Cranfield Univ., UK; Verification of Design Methods by Test and Analysis: Proceedings; 1998, pp. 11.1 - 11.11; In English; See also 19990071044; Copyright; Avail: Issuing Activity (The Royal Aeronautical Society, 4 Hamilton Place, London, W1V 0BQ, UK), Hardcopy, Microfiche

Design for aircraft engine zone ventilation and fire certification has traditionally been driven by practical demonstration using standardised tests. For large structures in particular, the cost of carrying out such tests can become prohibitively expensive. Numerical simulation provides the opportunity to investigate structure and component performance both during normal operation and in the event of fire and thereby promote greater integrated design. One of the major problems in any numerical simulation of a complex geometrical system is obtaining a suitable representation of the geometry to be used in the simulation process - in this case structured and unstructured grid generation and Computational Fluid Dynamics (CFD) analysis. With current Computer Aided Design (CAD) practices, the geometry is not in a suitable form and with large datasets such as those used here, the problems are often exacerbated. The challenges associated with the identification of a suitable geometry subset from the full engine assembly tree, filtering of unusable detail and additional CAD preparation for the grid generation are addressed. The realization of tractable but representative geometries is illustrated by examples characteristic of the Trent engine family, of the key physical processes. During normal operation this encompasses the ram inlet zone ventilation flow, including heat transfer from engine casings and accessories, whilst for a fire event this will additionally include the interaction with the buoyantly driven fire plume. The scenario investigated in this paper is that of a burner-simulated gearbox fire. Predictions of the internal velocity field, gas temperatures and composition and wall heat fluxes are compared with experimental measurements on a 1/2 scale nacelle fire test rig and, for the ventilation flow, with visualisation using dye and bubble tracers in a Perspex model of similar scale by water analogy. The numerical simulations capture important features of this complex flowfield and are shown to identify a number of distinct opportunities for design refinement.

Author

Ventilation; Flow Distribution; Fires; Inlet Flow; Certification; Nacelles; Computerized Simulation; Component Reliability; Validity; Aircraft Engines; Design Analysis

19990075036 Kyushu Univ., Inst. of Advanced Material Study, Kasuga, Japan

Heat Transfer and Flow Characteristics of Pure Refrigerant HCFC123 in Falling Film Type Plate-Fin Evaporator

Koyama, Shigeru, Kyushu Univ., Japan; Ohara, Junichi, Kyushu Univ., Japan; Kuwahara, Ken, Kyushu Univ., Japan; Nishiyama, Hiroyasu, Kyushu Univ., Japan; The Reports of Institute of Advanced Material Study, Kyushu University; 1996; ISSN 0914-3793; Volume 10, No. 2, pp. 137-144; In Japanese; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

In the present study, the characteristics of heat transfer and flow pattern are investigated experimentally for the falling film evaporation of pure refrigerant HCFC123 in a rectangular channel with a serrated-fin surface. The distributor is set at the top of the channel to supply the refrigerant liquid uniformly. The liquid flowing down vertically is heated electrically from the rear wall of the channel. A transparent vinyl chloride resin plate is placed as the front wall in order to observe the flow pattern in evaporation process directly. The experimental ranges are as follows: the mass velocity $G = 28$ approx. $70 \text{ kg}/(\text{sq m/s})$, the heat flux $q = 20$ approx. $50 \text{ kW}/\text{sq m}$ and the pressure P approx. $= 100 \text{ kPa}$. It is clarified that the heat transfer coefficient α depends on G and q in the region of vapor quality x greater than or equal to 0.3, while there is little influence of G and q in the region x less than or equal to 0.3. From the direct observation, the relation between heat transfer and flow pattern is clarified. The results of α are also compared with some previous correlation equations.

Author

Heat Transfer; Flow Characteristics; Refrigerants; Evaporators; Fins; Fluid Films

19990075037 Kyushu Univ., Inst. of Advanced Material Study, Kasuga, Japan

An Approximate Solution for Film Condensation of Pure Refrigerant on a Finned Vertical Surface

Koyama, Shigeru, Kyushu Univ., Japan; Yu, Jian, Kyushu Univ., Japan; Matsumoto, Tatsuya, Kyushu Univ., Japan; The Reports of Institute of Advanced Material Study, Kyushu University; 1996; ISSN 0914-3793; Volume 10, No. 2, pp. 129-136; In Japanese;

No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

A numerical analysis for the laminar film condensation of pure refrigerant on a finned vertical surface is carried out to clarify the heat transfer characteristics of plate-fin condensers. The fin and liquid film shapes are simplified, and the governing equations of the liquid film and one-dimensional heat conduction equation in the fin are solved numerically using the finite difference method. Three dimensional distribution of the fin temperature and the distribution of liquid film thickness along vertical direction are obtained. The effects of fin shape parameters on heat transfer enhancement ratio and fin efficiency are examined. A dimensionless correlation equation for liquid film heat transfer is also proposed.

Author

Approximation; Film Condensation; Refrigerants; Numerical Analysis; Fins; Finite Difference Theory; Conductive Heat Transfer

19990072764 NASA Langley Research Center, Hampton, VA USA

First International Symposium on Strain Gauge Balances, Part 2

Tripp, John S, Editor, NASA Langley Research Center, USA; Tcheng, Ping, Editor, NASA Langley Research Center, USA; First International Symposium on Strain Gauge Balances; March 1999; 322p; In English; 1st; International Symposium on Strain Gauge Balances, 22-25 Oct. 1996, Hampton, VA, USA; Sponsored by NASA, USA; See also 19990072765 through 19990072788 Contract(s)/Grant(s): RTOP 992-35-12-18

Report No.(s): NASA/CP-1999-209101/PT2; NAS 1.55:209101/PT2; L-17809B; No Copyright; Avail: CASI; A14, Hardcopy; A03, Microfiche

The first International Symposium on Strain Gauge Balances was sponsored and held at NASA Langley Research Center during October 22-25, 1996. The symposium provided an open international forum for presentation, discussion, and exchange of technical information among wind tunnel test technique specialists and strain gauge balance designers. The Symposium also served to initiate organized professional activities among the participating and relevant international technical communities. Over 130 delegates from 15 countries were in attendance. The program opened with a panel discussion, followed by technical paper sessions, and guided tours of the National Transonic Facility (NTF) wind tunnel, a local commercial balance fabrication facility, and the LaRC balance calibration laboratory. The opening panel discussion addressed "Future Trends in Balance Development and Applications." Forty-six technical papers were presented in 11 technical sessions covering the following areas: calibration, automatic calibration, data reduction, facility reports, design, accuracy and uncertainty analysis, strain gauges, instrumentation, balance design, thermal effects, finite element analysis, applications, and special balances. At the conclusion of the Symposium, a steering committee representing most of the nations and several U.S. organizations attending the Symposium was established to initiate planning for a second international balance symposium, to be held in 1999 in the UK.

Author

Conferences; Strain Gauge Balances; Calibrating; Instrument Errors; Wind Tunnel Apparatus; Dynamometers; Wind Tunnels

19990072767 Modern Machine and Tool Co., Newport News, VA USA

Free Oscillation Dynamic Stability Balance System

Parker, Peter A., Modern Machine and Tool Co., USA; First International Symposium on Strain Gauge Balances; March 1999, Pt. 2, pp. 455-466; In English; See also 19990072764; No Copyright; Avail: CASI; A03, Hardcopy; A03, Microfiche

A dynamic stability balance system has been designed and implemented using a large amplitude free oscillation technique to determine the damping characteristics of a wind tunnel model containing a moving payload which causes changes in the center of gravity during flight. The ceiling mounted system consists of a dynamic stability balance, a variable angle of attack tunnel interface plate, a model strut which passes into the tunnel test section, and a remote operation control panel. The balance consists of four load carrying flexures and one measurement flexure. Two full strain gage bridges, a foil resistive strain gage bridge and a piezoresistive strain gage bridge, were installed on the measurement flexure. Angular deflection is collected from the foil strain gage bridge and dynamic response data is recorded from the piezoresistive bridge. The dynamic stability balance was designed with removable load carrying flexures which allows the system spring constant to be changed for transonic and subsonic testing of a model. A removable inertial disk is used in conjunction with the removable flexures to change the frequency and damping time constant of the balance oscillation. The nominal angle of attack of the model is set using the tunnel interface plate which allows for plus and minus ninety degree rotation. Operation of the balance is accomplished by remotely cocking and latching the balance to an initial angle of five degrees and then releasing the latch to begin oscillation. The damping time, frequency and amplitude are recorded with the model subjected to controlled aerodynamic conditions. Comparison of the data obtained at the various aerodynamic conditions yields the damping characteristics of the model.

Author

Oscillations; Dynamic Response; Dynamic Stability; Design Analysis; Balancing; Aerodynamic Balance; Systems Engineering

19990072770 Modern Machine and Tool Co., Newport News, VA USA

Development of a Five Component Balance as an Integral Part of a Control Surface

Patel, Naresh R., Modern Machine and Tool Co., USA; First International Symposium on Strain Gauge Balances; March 1999, Pt. 2, pp. 493-510; In English; See also 19990072764; No Copyright; Avail: CASI; A03, Hardcopy; A03, Microfiche

A five component balance has been designed, manufactured and calibrated at Modern Machine & Tool Co., Inc.. The balance is used to measure aerodynamic forces on wind tunnel test models. The balance was designed to measure Normal Force, Axial Force, Pitching Moment, Rolling Moment and Yawing Moment generated on a horizontal stabilizer of a wind tunnel test model. A unique feature of the balance is that the load carrying strain gaged flexures were machined as an integral part of the control surface due to space limitations. This was accomplished by using the electrical discharge machining process. The integral design eliminates mechanical joints and greatly reduces errors due to hysteresis. The five component integral control surface balance has demonstrated performance comparable to wind tunnel balances used currently in the aerospace industry.

Author

Design Analysis; Balance; Fabrication; Calibrating; Components; Aerodynamic Forces; Wind Tunnel Apparatus; Stabilizers (Fluid Dynamics)

19990072772 NASA Langley Research Center, Hampton, VA USA

NASA LaRC Strain Gage Balance Design Concepts

Rhew, Ray D., NASA Langley Research Center, USA; First International Symposium on Strain Gauge Balances; March 1999, Pt. 2, pp. 525-541; In English; See also 19990072764; No Copyright; Avail: CASI; A03, Hardcopy; A03, Microfiche

The NASA Langley Research Center (LaRC) has been designing strain-gage balances for more than fifty years. These balances have been utilized in Langley's wind tunnels, which span over a wide variety of aerodynamic test regimes, as well as other ground based test facilities and in space flight applications. As a result, the designs encompass a large array of sizes, loads, and environmental effects. Currently Langley has more than 300 balances available for its researchers. This paper will focus on the design concepts for internal sting mounted strain-gage balances. However, these techniques can be applied to all force measurement design applications. Strain-gage balance concepts that have been developed over the years including material selection, sting, model interfaces, measuring, sections, fabrication, strain-gaging and calibration will be discussed.

Author

Design Analysis; Strain Gage Balances; Wind Tunnel Tests; Fabrication; Calibrating; Aerodynamic Characteristics

19990072778 NASA Langley Research Center, Hampton, VA USA

Finite Element Analysis of a NASA National Transonic Facility Wide Tunnel Balance

Lindell, Michael C., Editor, NASA Langley Research Center, USA; First International Symposium on Strain Gauge Balances; March 1999, Pt. 2, pp. 595-606; In English; See also 19990072764; No Copyright; Avail: CASI; A03, Hardcopy; A03, Microfiche

This paper presents the results of finite element analyses and correlation studies performed on a NASA National Transonic Facility (NTF) Wind Tunnel balance. In the past NASA has relied primarily on classical hand analyses, coupled with relatively large safety factors, for predicting maximum stresses in wind tunnel balances. Now, with the significant advancements in computer technology and sophistication of general purpose analysis codes, it is more reasonable to pursue finite element analyses of these balances. The correlation studies of the present analyses show very good agreement between the analyses and data measured with strain gages and therefore the studies give higher confidence for using finite element analyses to analyze and optimize balance designs in the future.

Author

Finite Element Method; Transonic Wind Tunnels; Balancing; Correlation

19990072779 Technische Univ., Darmstadt, Germany

Optimization of Internal Strain-Gage Windtunnel Balances with Finite Elements Computation

Zhai, Junnai, Technische Univ., Germany; Hufnagel, K., Technische Univ., Germany; First International Symposium on Strain Gauge Balances; March 1999, Pt. 2, pp. 607-617; In English; See also 19990072764; No Copyright; Avail: CASI; A03, Hardcopy; A03, Microfiche

The internal strain gage balance is one of the most important instrumentation in the wind tunnel. The more and more intensive competition in the airplane industry has set higher demands on the balance. to design and construct such a balance that can meet those demands all aspects of the balance technology must be investigated. In this paper only the structure of the internal strain gage balance is considered. From the point of view of structure these high demands on the balance can be expressed as: (1) lower interference; (2) higher stiffness Lower stress level at the strain gage positions and the related parts; (3) capability of tolerating errors from the temperature gradients. Among these demands the interference and stiffness are most important for a transport

balance, thus only these two properties are studied in this paper. For this study the Finite Elements Method (FEM) is best suitable. With this method the various influence factors can be systematically analyzed. Based on the analysis the structure of the balance can be optimized in three levels. At first the balance structure is optimized by choosing the key geometric parameters. Then various shapes for the parts of an internal balance are discussed. Finally different configurations for the internal strain gage balance are studied. Through a parameter optimization the total linear interference on the drag can be reduced from 6.1% to 3.8% of the F.S. signal. by using the configurations with two symmetrical planes the interference can be reduced to 2.5% of the F.S. signal. by using the point symmetrical configuration the interference on the drag can be reduced to 0.5% of the F.S. signal. This is almost interference-free. The stiffness in axial direction is mainly affected by the parallelograms. by choosing proper dimensions for the drag measuring beam, the stiffness of the balance in X-axis can be doubled. But the stiffness in other directions is hardly changed. The stiffness in normal and side direction is mainly affected by the main beams and the moment measuring elements. by using the new main beams, the combined main beams, the stiffness of the balance in Z-axis can be 21% than that of the dovetail matched form. An further improvement of the stiffness can be achieved by using the shear spring as moment measuring element. A new moment measuring element of this kind is therefore put forward. The FEM computation shows that alone with this element the stiffness in Z-axis can be raised by 65%. It is to recognize from this study that at the present level of technology there is no structure for a balance that is optimal in all respects. The best solution may be a requirement-oriented design, i.e., to design a balance structure according to the concrete requirements.

Author

Optimization; Strain Gages; Wind Tunnels; Finite Element Method; Stress-Strain Relationships; Strain Gage Balances

19990072784 China Aerodynamics Research and Development Center, Mianyang, China

Development and Application of Microbalance in Hypersonic Low Density Wind Tunnel

Zhigong, Tang, China Aerodynamics Research and Development Center, China; Yanguang, Yang, China Aerodynamics Research and Development Center, China; First International Symposium on Strain Gauge Balances; March 1999, Pt. 2, pp. 669-676; In English; See also 19990072764; No Copyright; Avail: CASI; A02, Hardcopy; A03, Microfiche

This paper summarized the study of aerodynamic measuring technique in Hypersonic Low Density Wind Tunnel (HLDWT) of CARD, and described the development and application of microbalance, and discussed the directions of development of microbalance in HLDWT.

Author

Research; Microbalances; Measuring Instruments; Flight Simulation

19990072788 NASA Langley Research Center, Hampton, VA USA

Summary Report of the First International Symposium on Strain Gauge Balances and Workshop on AoA/Model Deformation Measurement Techniques

Tripp, John S., NASA Langley Research Center, USA; Tchong, Ping, NASA Langley Research Center, USA; Burner, Alpheus W., NASA Langley Research Center, USA; Finley, Tom D., NASA Langley Research Center, USA; First International Symposium on Strain Gauge Balances; March 1999, Pt. 2, pp. 727-738; In English; See also 19990072764; No Copyright; Avail: CASI; A03, Hardcopy; A03, Microfiche

The first International Symposium on Strain Gauge Balances was sponsored under the auspices of the NASA Langley Research Center (LaRC), Hampton, Virginia during October 22-25, 1996. Held at the LaRC Reid Conference Center, the Symposium provided an open international forum for presentation, discussion, and exchange of technical information among wind tunnel test technique specialists and strain gauge balance designers. The Symposium also served to initiate organized professional activities among the participating and relevant international technical communities. The program included a panel discussion, technical paper sessions, tours of local facilities, and vendor exhibits. Over 130 delegates were in attendance from 15 countries. A steering committee was formed to plan a second international balance symposium tentatively scheduled to be hosted in the UK in 1998 or 1999. The Balance Symposium was followed by the half-day Workshop on Angle of Attack and Model Deformation on the afternoon of October 25. The thrust of the Workshop was to assess the state of the art in angle of attack (AoA) and model deformation measurement techniques and to discuss future developments.

Author

Conferences; Strain Gage Balances; Angle of Attack

19990079856 Allison Advanced Development Co., Indianapolis, IN USA

High Temperature Foil Air Bearing Development for a Missile/UAV Engine Application

Kirschmann, Arthur, Allison Advanced Development Co., USA; Agrawal, G. L., R/D Dynamics Corp., USA; 1998 JANNAF Propulsion Meeting; Jul. 1998; Volume 1, pp. 101-107; In English; See also 19990079846; No Copyright; Avail: Issuing Activity

(CPIA, 10630 Little Patuxent Pkwy., Suite 202, Columbia, MD 21044-3200), Hardcopy, Microfiche

The elimination of lubricated rolling element bearings in small turbine engines and their replacement with foil air bearings will result in the elimination of costly and complex oil subsystems as well as decreased engine weight and volume. Today, almost all aircraft air cycle machines use foil bearings with great success and reliability; however, the severe thermal and mechanical load environments have precluded their use in the turbine engines. The objective of the effort undertaken was to develop a foil air bearing to replace the rear roller bearing and attendant lube system of the Allison J104-AD-100 turbojet. The foil air bearing is required to operate at temperatures up to 900 F, with side-loads of up to 10 g's and at speeds up to 54,000 rpm. The bearing was designed with particular emphasis on the above parameters and a component test plan was devised to clear the bearing for operation in the turbine engine environment. Foil and shaft coatings adhered well, showed no oxidation or cracking under flexure after four, 900 F two hour cycles. Stable operation with no sub-synchronous vibration was verified during a 100 cycle, stop-to-max speed, five hour endurance. A 20 g side-load capability was verified with a minimal shaft orbit and no torque shift during load application as well as no signs of excessive foil wear. Based on these results, the bearing is cleared for demonstration in the J104-AD-100.

Author

High Temperature Air; Turbine Engines; Engine Design; Roller Bearings; Foil Bearings

19990077742 Boeing Information, Space and Defense Systems, Seattle, WA USA

Exploratory Nondestructive Evaluation (NDE) Research for Advanced Materials and Processes, Volume 2, Shearography Improvements *Final Report, 1 Jul. 1995 - 30 Apr. 1998*

Bossi, Richard, Boeing Information, Space and Defense Systems, USA; Knutson, Benjamin, Boeing Information, Space and Defense Systems, USA; Nerenberg, Robert, Boeing Information, Space and Defense Systems, USA; Deobald, Lyle, Boeing Information, Space and Defense Systems, USA; Nelson, James, Boeing Information, Space and Defense Systems, USA; Jul. 1998; 51p; In English

Contract(s)/Grant(s): F33615-95-C-5225; AF Proj. 4349

Report No.(s): AD-A365635; D950-10333-1-VOL-2; AFRL-ML-WP-TR-1999-4010; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

Shearography Improvements: Shearographic inspection of aerospace structures has not gained wide acceptance, owing to the difficulty of interpreting shearographic images. A feature extraction method was developed that calculates surface normal curvature from input shearograms. The method can be applied in real time to provide a technician unambiguous images representing areas of locally high curvature, which will generally highlight the boundaries of flaws. Images are load independent and insensitive to part viewing angle. Analytical and experimental validation tests were completed for vacuum, vibrational and thermal loading. Recommendations are presented for system development, and for practical implementation of shearography.

DTIC

Aircraft Structures; Nondestructive Tests; Shearography; Composite Materials; Real Time Operation; Computer Assisted Instruction; Inspection

19990077743 Boeing Information, Space and Defense Systems, Seattle, WA USA

Exploratory Nondestructive Evaluation (NDE) Research for Advanced Materials and Processes, Volume 3, Interactive Multimedia Computer Based Training (IMCBT) for Nondestructive Evaluation/Inspection (NDE/I) Personnel *Final Report, 1 Jul. 1995 - 30 Apr. 1998*

Bossi, Richard, Boeing Information, Space and Defense Systems, USA; Knutson, Benjamin, Boeing Information, Space and Defense Systems, USA; Nerenberg, Robert, Boeing Information, Space and Defense Systems, USA; Deobald, Lyle, Boeing Information, Space and Defense Systems, USA; Nelson, James, Boeing Information, Space and Defense Systems, USA; Jul. 1998; 33p; In English

Contract(s)/Grant(s): F33615-95-C-5225; AF Proj. 4349

Report No.(s): AD-A365636; D950-10333-1-VOL-3; AFRL-ML-WP-TR-1999-4011; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Interactive Multimedia Computer Based Training (IMCBT) for Nondestructive Inspection (NDE/I) Personnel: Computer Based Training (CBT) is a highly effective method for industrial training that has been growing in popularity. Text, graphics, sound, movies and animation enhance the learning activity. Interactive Multimedia CBT (IMCBT) allows students to learn in an environment where the training material is presented on a computer workstation and uses student interaction and feedback in the learning process. This technology has been used in the aerospace industry for aircraft maintenance and flight training and is growing in many operation training areas. The cost of development of IMCBT material is significantly more expensive than traditional training material, but an hour of IMCBT material can contain more information than an hour of traditional training material since information is transferred faster and with higher retention. Because IMCBT delivers training at lower cost, the

overall benefit of IMCBT has been found to be in the range of 40% to 60% cost savings. The application of IMCBT for NDE/I training did show an overwhelmingly positive acceptance of the incorporation of IMCBT for NDE/I personnel within existing training structures. A CD-ROM package called INSPECT (Interactive Student Paced Eddy Current Training) has demonstrate various advanced aspects of potential IMCBT lessons. The INSPECT CD demonstration was reviewed by Air Force and industry professionals, as well as a group of high school students to gauge novice response. The prototype was found to be appealing and to have significant potential as a useful teaching tool. A large majority of the professional reviewers stated they would like to have complete CBT modules like INSPECT for some aspect of their NDE/I training.

DTIC

Nondestructive Tests; Composite Materials; Computer Assisted Instruction; Aircraft Maintenance; Eddy Currents; Maintenance Training

13 GEOSCIENCES

Includes geosciences (general); earth resources and remote sensing; energy production and conversion; environment pollution; geophysics; meteorology and climatology; and oceanography.

19990080912 NASA Goddard Space Flight Center, Greenbelt, MD USA

Earth Observing System: Present Capabilities and Promises for the Future

King, Michael D., NASA Goddard Space Flight Center, USA; 1999; 1p; In English; 10th; Atmospheric Radiation, 28 Jun. - 2 Jul. 1999, Madison, WI, USA; Sponsored by Army Map Service, USA; No Copyright; Avail: Issuing Activity, Hardcopy; Abstract Only

The Earth Observing System (EOS) is a space-based observing system comprised of a series of satellite sensors by which scientists can monitor the Earth, a Data and Information System (EOSDIS) enabling researchers worldwide to access the satellite data, and an interdisciplinary science research program to interpret the satellite data. During this year 5 EOS science missions are scheduled for launch, representing observations of (i) total solar irradiance, (ii) Earth radiation budget, (iii) land cover & land use change, (iv) ocean processes (vector wind, sea surface temperature, and ocean color), (v) atmospheric processes (aerosol and cloud properties, water vapor, and temperature and moisture profiles), and (vi) atmospheric chemistry (both tropospheric and stratospheric). In succeeding years many more satellites will be launched that will contribute immeasurably to our understanding of the Earth's environment. In this presentation I will describe how scientists intend to use MODIS, an earth-viewing cross-track scanning spectroradiometer to be launched on the Terra satellite in summer 1999, for the remote sensing of cloud and aerosol properties. MODIS will scan a swath width sufficient to provide nearly complete global coverage every two days from a polar-orbiting, sun-synchronous, platform at an altitude of 705 km. In addition, I will describe key elements of other instruments recently launched or planned for flight in the coming months. Finally, I will lay out a plan for the future space-based observing system being planned by NASA and its partners.

Author

Earth Observing System (EOS); EOS Data and Information System; Imaging Spectrometers; Remote Sensing; Satellite Instruments; Flight Instruments; Satellite Observation; Swath Width; Spectroradiometers

19990087369 NASA Goddard Space Flight Center, Greenbelt, MD USA

Assessing the Impact of Aircraft Emissions on the Stratosphere

Kawa, S. R., NASA Goddard Space Flight Center, USA; Anderson, D. E., NASA Goddard Space Flight Center, USA; [1999]; 13p; In English; Original contains color illustrations; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

For the past decade, the NASA Atmospheric Effects of Aviation Project (AEAP) has been the U.S. focal point for research on aircraft effects. In conjunction with U.S. basic research programs, AEAP and concurrent European research programs have driven remarkable progress reports released in 1999 [IPCC, 1999; Kawa et al., 1999]. The former report primarily focuses on aircraft effects in the upper troposphere, with some discussion on stratospheric impacts. The latter report focuses entirely on the stratosphere. The current status of research regarding aviation effects on stratospheric ozone and climate, as embodied by the findings of these reports, is reviewed. The following topics are addressed: Aircraft Emissions, Pollution Transport, Atmospheric Chemistry, Polar Processes, Climate Impacts of Supersonic Aircraft, Subsonic Aircraft Effect on the Stratosphere, Calculations of the Supersonic Impact on Ozone and Sensitivity to Input Conditions.

CASI

Stratosphere; Nitrogen Oxides; Ozone; Atmospheric Composition; Exhaust Emission; Atmospheric Effects; Air Pollution; Transport Aircraft

14
LIFE SCIENCES

Includes life sciences (general); aerospace medicine; behavioral sciences; man/system technology and life support; and space biology.

19990078620 Army Aeromedical Research Lab., Fort Rucker, AL USA

The Effects of Modafinil on Aviator Performance During 40 Hours of Continuous Wakefulness: A UH-60 Helicopter Simulator Study *Final Report*

Caidwell, John A., Jr.; Smythe, Nicholas K., III; Caidwell, J. L.; Hall, Kecia K.; Norman, David N.; Jun. 1999; 59p; In English
Contract(s)/Grant(s): Proj-3M162787A879

Report No.(s): AD-A365558; USAARL-99-17; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

This research evaluated the efficacy of the stimulant modafinil for sustaining simulator flight performance, cognitive skill, psychological mood, and central nervous system (CNS) activation in helicopter pilots who had been deprived of sleep. Six Army helicopter pilots were each exposed to two 40-hour periods of continuous wakefulness separated by one night of recovery sleep. In one of the periods, three 200-mg doses of modafinil were given (at 2300, 0300, and 0700) and in the other period, matching placebo tablets were administered. Testing sessions, which included UH-60 simulator flights, EEG evaluations, Profile of Mood States (POMS) and Visual Analog Scale (VAS) questionnaires, a desktop flight simulator task, and the Multi-Attribute Task Battery (MATB), were conducted at 0900, 1300, and 1700 on baseline days, and at 0100, 0500, 0900, 1300, and 1700 during sleep deprivation periods. Modafinil significantly attenuated the effects of sleep deprivation on four of the six flight maneuvers. Performance on the straight-and-levels, straight descents, left standard-rate turns, and left descending turn was maintained at or near baseline levels by modafinil, whereas performance suffered under placebo. In addition, modafinil reduced the amount of slow-wave EEG activity (indicative of reduced CNS activation), lessened self-reported problems with mood and alertness (diminished vigor, energy, confidence, etc.), and curtailed the performance decrements (slower response times, increased response lapses, and elevated tracking errors) that were found under placebo. The most noticeable benefits from the drug were seen between approximately 0330 and 1130 when the combined impact of sleep loss and the circadian trough was most severe. The positive effects of this compound were not offset by disruptions in recovery-sleep architecture.

DTIC

Wakefulness; Aircraft Pilots; Flight Simulators; Aerospace Medicine

19990071326 Anacapa Sciences, Inc., Santa Barbara, CA USA

Development of a Flight Simulator and an Intelligent Symbology Management System for Helmet Mounted Displays in Rotorcraft *Final Report, 21 Jun. 1996 - 9 Feb. 1999*

Rogers, Steven P.; Asbury, Charles N.; Feb. 09, 1999; 191p; In English

Contract(s)/Grant(s): DAAJ02-96-C-0042

Report No.(s): AD-A365110; AS-FR-1184; No Copyright; Avail: CASI; A02, Microfiche; A09, Hardcopy

The overall objective of this project was to develop and evaluate an innovative and intelligent information presentation system for helmet-mounted displays (HMDs) in military helicopters. The subordinate objectives included: (a) defining specific information elements that should be presented via the HMD, (b) developing a powerful, portable, flight simulator to permit rapid identification and evaluation of candidate symbols and their management, and (copyright) developing and testing innovative flight and mission information symbology management concepts, realistically demonstrating the most promising candidates on the portable simulator. The report describes the symbology management issues of mode switching and information organization and the heavy burden of Army mission management tasks, and presents HMD solutions to the current shortcomings, focusing on "augmented reality" as the key to workload reduction and situation awareness enhancement. The report also describes the design and development of the PRISMS virtual reality flight simulator, and how it was used to conduct a formal experiment with 14 Apache pilots. The experiment demonstrated the overwhelming advantages of new earth-fixed HMD symbols such as way point and engagement area markers. A wealth of pilot comments and subjective ratings on these and other symbols and their intelligent management is also presented.

DTIC

Flight Simulators; Management Systems; Helmet Mounted Displays; Rotary Wing Aircraft; Military Helicopters; Information Management

MATHEMATICAL AND COMPUTER SCIENCES

Includes mathematical and computer sciences (general); computer operations and hardware; computer programming and software; computer systems; cybernetics; numerical analysis; statistics and probability; systems analysis; and theoretical mathematics.

19990079365 NASA Marshall Space Flight Center, Huntsville, AL USA

Expert System Software Assistant for Payload Operations

Rogers, Mark N., NASA Marshall Space Flight Center, USA; 1997; 1p; In English; Technology 2007, 22-24 Sep. 1997, Boston, MA, USA; Copyright; Avail: Issuing Activity, Hardcopy; Abstract Only

The broad objective of this expert system software based application was to demonstrate the enhancements and cost savings that can be achieved through expert system software utilization in a spacecraft ground control center. Spacelab provided a valuable proving ground for this advanced software technology; a technology that will be exploited and expanded for future ISS operations. Our specific focus was on demonstrating payload cadre command and control efficiency improvements through the use of "smart" software which monitors flight telemetry, provides enhanced schematic-based data visualization, and performs advanced engineering data analysis.

Derived from text

Expert Systems; Ground Based Control; Flight Control; Spacecraft Control; Telemetry

19990079857 CFD Research Corp., Huntsville, AL USA

Tactical Missile Analysis Using the GEMA Software System

Ostrander, Mark J., CFD Research Corp., USA; 1998 JANNAF Propulsion Meeting; Jul. 1998; Volume 1, pp. 109-116; In English; See also 19990079846; No Copyright; Avail: Issuing Activity (CPIA, 10630 Little Patuxent Pkwy., Suite 202, Columbia, MD 21044-3200), Hardcopy, Microfiche

The GEMA software was written for the PC and is a graphically-based system consisting of modules for 3 DOF trajectory, engine cycle options, missile packaging, vehicle aerodynamics, etc. The software permits the user to complete preliminary-design analysis trades to evaluate missile performance using different missile configurations, propulsion options, trajectories, etc. As an example, this paper discusses preliminary mission performance of an Advanced Fire Support System (AFSS) missile based on public domain information available over the internet.

Author

Missiles; Computer Programs; Computer Aided Design; Modules; Design Analysis; Aerodynamic Characteristics

19990084095 Army Research and Technology Labs., Moffett Field, CA USA

Comment on "Linear and Nonlinear Analysis of a Nonconservative Frame of Divergence Instability"

Hodges, Dewey H., Army Research and Technology Labs., USA; AIAA Journal; November 1982; Volume 20, No. 11, pp. 1629-1630; In English

Report No.(s): AIAA Paper 82-4267; Copyright; Avail: Issuing Activity, Hardcopy

Recently, Kounadis and Avraam presented an analysis of the divergence instability of nonconservatively loaded frames. The purpose for their work, as expressed in their introduction, needs some clarification. Furthermore, the nonlinear static analysis contains an error that, although it may not seriously affect the results and conclusions, is worth noting because it could affect the results for more complicated systems. There are three questions raised in the introduction that, according to the authors, need to be addressed in further research. The document presents a discussion of these questions.

Derived from text

Nonlinearity; Divergence; Nonlinear Equations; Mathematical Models; Dynamic Structural Analysis; Aerodynamic Stability; Airframes

16 PHYSICS

Includes physics (general); acoustics; atomic and molecular physics; nuclear and high-energy; optics; plasma physics; solid-state physics; and thermodynamics and statistical physics.

19990077358 Chinese Inst. of Engineers, Taipei, Taiwan, Province of China

Noise Reduction of a Cross-Flow Fan

Lee, Da-Sheng, Industrial Technology Research Inst., Taiwan, Province of China; Chen, Ping-Hei, National Taiwan Univ., Taiwan, Province of China; Miao, Jr-Ming, National Taiwan Univ., Taiwan, Province of China; Journal of The Chinese Institute of Engineers: Transactions of the Chinese Institute of Engineers, Series A; May 1997; ISSN 0253-3839; Volume 20, No. 3, pp. 265-273; In English; No Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

This study attempts to reduce the aerodynamic sound noise from a cross-flow fan by varying the geometrical parameters of the cross-flow fan as the similar amount of air flow rate is delivered by the cross-flow fan. Two different rotors (fixed-pitch and staggered-pitch) and tongues (wedge-shape and saw-tooth shape), and four different tongue clearances ($\epsilon = 3$ mm, 5 mm, 7 mm, and 10 mm) are also tested. At Ω is greater than or $= 1200$ r/min, a screech tone produced from the peak sound pressure levels at the harmonics of blade passage frequency always occurs for the cross-flow fan with the fixed-pitch rotor, the wedge shape, and $\epsilon = 3$ mm. At Ω is greater than or $= 1200$ r/min, the sound pressure level at the first harmonic of blade passage frequency is significantly reduced by either replacing the fixed-pitch rotor with the staggered-pitch one as well as replacing the wedge-shape with the saw-tooth tongue or enlarging the tongue clearance. However, the overall sound pressure level from the cross-flow fan to deliver the same air flow rate is slightly changed with geometrical parameters varied in this study.

Author

Aerodynamic Noise; Rotor Aerodynamics; Aeroacoustics; Cross Flow; Air Flow; Rotors

19990079391 NASA Langley Research Center, Hampton, VA USA

Tiltrotor Aeroacoustic Code (TRAC) Prediction Assessment and Initial Comparisons With TRAM Test Data

Burley, Casey L., NASA Langley Research Center, USA; Brooks, Thomas F., NASA Langley Research Center, USA; Charles, Bruce D., Boeing Co., USA; McCluer, Megan, NASA Ames Research Center, USA; 1999; 20p; In English; 25th; European Rotorcraft, 14-16 Sep. 1999, Rome, Italy

Report No.(s): Paper-B3; No Copyright; Avail: Issuing Activity, Hardcopy

A prediction sensitivity assessment to inputs and blade modeling is presented for the TiltRotor Aeroacoustic Code (TRAC). For this study, the non-CFD prediction system option in TRAC is used. Here, the comprehensive rotorcraft code, CAMRAD.Mod 1, coupled with the high-resolution sectional loads code HIREs, predicts unsteady blade loads to be used in the noise prediction code WOPWOP. The sensitivity of the predicted blade motions, blade airloads, wake geometry, and acoustics is examined with respect to rotor rpm, blade twist and chord, and to blade dynamic modeling. to accomplish this assessment, an interim input-deck for the TRAM test model and an input-deck for a reference test model are utilized in both rigid and elastic modes. Both of these test models are regarded as near scale models of the V-22 proprotor (tiltrotor). With basic TRAC sensitivities established, initial TRAC predictions are compared to results of an extensive test of an isolated model proprotor. The test was that of the TiltRotor Aeroacoustic Model (TRAM) conducted in the Duits-Nederlandse Windtunnel (DNW). Predictions are compared to measured noise for the proprotor operating over an extensive range of conditions. The variation of predictions demonstrates the great care that must be taken in defining the blade motion. However, even with this variability, the predictions using the different blade modeling successfully capture (bracket) the levels and trends of the noise for conditions ranging from descent to ascent.

Author

Aeroacoustics; Noise Prediction (Aircraft); V-22 Aircraft; Aircraft Noise

Subject Term Index

A

ACCIDENT PREVENTION, 13
ACOUSTIC EXCITATION, 41
ACTIVE CONTROL, 18, 41
ACTUATORS, 40
AEROACOUSTICS, 20, 58
AERODYNAMIC BALANCE, 51
AERODYNAMIC CHARACTERISTICS, 2, 4, 26, 52, 57
AERODYNAMIC CONFIGURATIONS, 4, 5, 46
AERODYNAMIC DRAG, 4, 20
AERODYNAMIC FORCES, 5, 52
AERODYNAMIC HEATING, 3, 43, 44
AERODYNAMIC LOADS, 20, 38
AERODYNAMIC NOISE, 58
AERODYNAMIC STABILITY, 57
AERODYNAMICS, 3, 5, 39
AEROELASTICITY, 24, 25, 26
AEROMANEUVERING, 43
AEROSPACE ENGINEERING, 22, 26, 27
AEROSPACE INDUSTRY, 23
AEROSPACE MEDICINE, 56
AEROSPACE VEHICLES, 22
AFTERBODIES, 20
AGING (METALLURGY), 37
AGREEMENTS, 8, 9
AIR BREATHING ENGINES, 46
AIR FLOW, 19, 31, 58
AIR JETS, 38
AIR LAUNCHING, 46
AIR NAVIGATION, 15
AIR POLLUTION, 55
AIR TRAFFIC, 10, 16
AIR TRAFFIC CONTROL, 15, 16
AIR TRANSPORTATION, 6, 7, 8, 9, 10, 11
AIRCRAFT COMPARTMENTS, 15
AIRCRAFT CONFIGURATIONS, 5, 26, 40
AIRCRAFT CONTROL, 40
AIRCRAFT DESIGN, 5, 13, 22, 25, 43
AIRCRAFT ENGINES, 1, 28, 29, 32, 35, 36, 37, 50
AIRCRAFT LANDING, 13, 43
AIRCRAFT MAINTENANCE, 23, 28, 29, 31, 32, 33, 55
AIRCRAFT NOISE, 20, 58
AIRCRAFT PARTS, 22, 49
AIRCRAFT PILOTS, 56

AIRCRAFT SAFETY, 11, 12, 28, 40
AIRCRAFT STRUCTURES, 22, 23, 27, 39, 54
AIRFOILS, 31
AIRFRAMES, 13, 14, 57
AIRLINE OPERATIONS, 6, 7, 8, 14
AIRPORT PLANNING, 11
AIRPORTS, 14, 15, 43
AIRSHIPS, 50
AIRSPEED, 23
ALUMINUM, 21
ALUMINUM ALLOYS, 21
ANALYSIS (MATHEMATICS), 38
ANECHOIC CHAMBERS, 42
ANGLE OF ATTACK, 53
ANTISYMMETRY, 38
APPLICATIONS PROGRAMS (COMPUTERS), 26, 34, 35, 36
APPROXIMATION, 51
ARMED FORCES, 13
ARTIFICIAL SATELLITES, 45
ASTRIONICS, 45
ATMOSPHERIC COMPOSITION, 55
ATMOSPHERIC EFFECTS, 55
ATMOSPHERIC ENTRY, 43
ATMOSPHERIC ENTRY SIMULATION, 43
AUTOMATIC CONTROL, 16
AVIONICS, 28, 45

B

BALANCE, 52
BALANCING, 51, 52
BALDWIN-LOMAX TURBULENCE MODEL, 20
BALLISTIC TRAJECTORIES, 3
BALLISTICS, 3
BOATTAILS, 20
BOOSTER ROCKET ENGINES, 44, 46
BOW WAVES, 3
BRAZING, 30
BUFFETING, 38

C

CALIBRATING, 51, 52
CASCADE FLOW, 41
CERTIFICATION, 50
CHECKOUT, 29

CIVIL AVIATION, 7, 9, 11, 12, 48
CLADDING, 21
CLEANING, 49
COATING, 30
COCKPITS, 16
COLLISION AVOIDANCE, 15
COLOR, 16
COLOR VISION, 16
COMBAT, 18
COMBUSTION CHAMBERS, 38, 49
COMBUSTION EFFICIENCY, 38
COMMERCE, 10
COMMERCIAL AIRCRAFT, 14, 26, 48
COMPATIBILITY, 24, 49
COMPETITION, 7, 9, 10
COMPONENT RELIABILITY, 50
COMPONENTS, 52
COMPOSITE MATERIALS, 22, 23, 54, 55
COMPOSITE STRUCTURES, 22, 23
COMPRESSOR BLADES, 1, 31, 34
COMPRESSOR ROTORS, 33
COMPUTATION, 35, 37
COMPUTATIONAL FLUID DYNAMICS, 1, 3, 5, 20, 33, 36
COMPUTATIONAL GRIDS, 3, 25, 35
COMPUTER AIDED DESIGN, 25, 27, 57
COMPUTER ASSISTED INSTRUCTION, 54, 55
COMPUTER PROGRAMMING, 17
COMPUTER PROGRAMS, 27, 33, 57
COMPUTERIZED SIMULATION, 1, 19, 34, 35, 36, 37, 50
CONDUCTIVE HEAT TRANSFER, 51
CONFERENCES, 1, 6, 12, 23, 28, 51, 53
CONGRESSIONAL REPORTS, 23
CONSTRUCTION, 42
CONTOURS, 31
CONTROL BOARDS, 39
CONTROL CONFIGURED VEHICLES, 40
CONTROL EQUIPMENT, 14, 26
CONTROL SYSTEMS DESIGN, 40
CONTROLLERS, 40
CONVECTIVE HEAT TRANSFER, 44
CORRELATION, 52
COST ANALYSIS, 9, 28
COST EFFECTIVENESS, 29, 36
COST REDUCTION, 28, 29, 46
COSTS, 18

CRACK INITIATION, 31
 CRACK PROPAGATION, 33, 37
 CRACKING (FRACTURING), 33
 CRASHES, 14, 27
 CREEP PROPERTIES, 33
 CROSS FLOW, 58
 CYCLES, 11

D

DAMAGE, 24, 29, 32, 35
 DAMAGE ASSESSMENT, 28, 32
 DATA ACQUISITION, 5, 19, 41
 DEBRIS, 19, 37
 DEFECTS, 29
 DEFENSE PROGRAM, 23
 DEICERS, 12, 22
 DEICING, 22
 DEMAND (ECONOMICS), 10, 11
 DEPOSITION, 30
 DERIVATION, 26
 DESIGN ANALYSIS, 1, 13, 18, 19, 20, 22, 23, 25, 26, 27, 34, 36, 50, 51, 52, 57
 DETECTION, 15
 DETERIORATION, 31, 32
 DIAMOND FILMS, 30
 DIAMONDS, 30
 DISKS, 33
 DISPLAY DEVICES, 12
 DIVERGENCE, 57
 DOSAGE, 26
 DRAG, 47
 DRAG REDUCTION, 20, 44
 DRAINAGE, 22
 DROP TESTS, 27
 DYNAMIC CHARACTERISTICS, 26
 DYNAMIC CONTROL, 26
 DYNAMIC RESPONSE, 24, 51
 DYNAMIC STABILITY, 51
 DYNAMIC STRUCTURAL ANALYSIS, 57
 DYNAMOMETERS, 51

E

EARTH OBSERVING SYSTEM (EOS), 55
 ECONOMETRICS, 10
 ECONOMIC ANALYSIS, 9
 ECONOMICS, 9, 11
 EDDY CURRENTS, 55
 EJECTION SEATS, 14
 ELASTIC BUCKLING, 35
 ELASTIC PROPERTIES, 35

ELECTRODYNAMICS, 47
 ELECTROHYDRODYNAMICS, 27
 ENGINE DESIGN, 1, 20, 33, 36, 37, 54
 ENGINE FAILURE, 29
 ENGINE INLETS, 19
 ENGINE MONITORING INSTRUMENTS, 33
 ENGINE PARTS, 28, 30, 31, 32, 35, 37, 46
 ENGINE TESTS, 31, 47
 ENHANCED VISION, 12
 EOS DATA AND INFORMATION SYSTEM, 55
 EQUIPMENT SPECIFICATIONS, 31
 EROSION, 31
 ESCAPE SYSTEMS, 14
 ESTIMATES, 2
 ESTIMATING, 23, 39
 EULER EQUATIONS OF MOTION, 3, 25
 EUROPE, 8, 9, 10
 EVALUATION, 14, 15
 EVAPORATORS, 50
 EXHAUST EMISSION, 55
 EXHAUST NOZZLES, 20
 EXPERIMENT DESIGN, 2
 EXPERIMENTATION, 4, 19, 36
 EXPERT SYSTEMS, 57
 EXTREMELY HIGH FREQUENCIES, 42

F

F-14 AIRCRAFT, 49
 F-15 AIRCRAFT, 21, 39
 FABRICATION, 24, 26, 52
 FAIL-SAFE SYSTEMS, 48
 FAILURE, 32
 FAILURE ANALYSIS, 28, 31
 FAILURE MODES, 32
 FATIGUE (MATERIALS), 21, 23, 29, 33
 FATIGUE LIFE, 29
 FATIGUE TESTS, 31
 FAULT DETECTION, 31
 FEEDBACK CONTROL, 17
 FIGHTER AIRCRAFT, 15, 28, 40
 FILM CONDENSATION, 51
 FINITE DIFFERENCE THEORY, 51
 FINITE ELEMENT METHOD, 35, 52, 53
 FINITE VOLUME METHOD, 3
 FINS, 50, 51
 FIRES, 15, 50
 FLIGHT CHARACTERISTICS, 46, 47
 FLIGHT CONTROL, 2, 40, 44, 57

FLIGHT INSTRUMENTS, 55
 FLIGHT PATHS, 15, 16
 FLIGHT PLANS, 16
 FLIGHT SAFETY, 11, 12, 18, 40, 45, 48
 FLIGHT SIMULATION, 2, 45, 53
 FLIGHT SIMULATORS, 40, 56
 FLIGHT TESTS, 2, 17, 21
 FLOW CHARACTERISTICS, 4, 19, 20, 37, 50
 FLOW DISTRIBUTION, 2, 4, 34, 36, 50
 FLUID FILMS, 50
 FLUTTER, 41
 FOIL BEARINGS, 54
 FORCE DISTRIBUTION, 5
 FORECASTING, 10, 11
 FOREIGN BODIES, 29, 35
 FORMING TECHNIQUES, 31
 FRACTURE MECHANICS, 31, 32
 FRACTURING, 21
 FREE FLOW, 3
 FUEL TANKS, 13, 14
 FUELS, 22
 FUNCTIONAL DESIGN SPECIFICATIONS, 45
 FUNNELS, 22
 FUSELAGES, 14, 27

G

GAME THEORY, 11
 GAS PATH ANALYSIS, 33
 GAS TURBINE ENGINES, 1, 28, 29, 31, 33, 35
 GAS TURBINES, 35, 36
 GLOBAL POSITIONING SYSTEM, 17
 GLYCOLS, 12, 22
 GRAVITY PROBE B, 45
 GRID GENERATION (MATHEMATICS), 3
 GROUND BASED CONTROL, 57
 GROUND EFFECT (AERODYNAMICS), 5
 GROUND STATIONS, 45
 GROUND SUPPORT EQUIPMENT, 31
 GROUND TESTS, 47
 GUIDANCE (MOTION), 16

H

HEALTH, 1, 18
 HEAT RESISTANT ALLOYS, 33
 HEAT TRANSFER, 27, 36, 50
 HELICOPTER CONTROL, 33
 HELICOPTER TAIL ROTORS, 24
 HELICOPTERS, 2, 18, 23, 24

HELMET MOUNTED DISPLAYS, 15, 56
HIGH TEMPERATURE AIR, 54
HIGH VOLTAGES, 27
HIGHLY MANEUVERABLE AIRCRAFT, 40
HUMAN FACTORS ENGINEERING, 16, 39, 43
HYPERSONIC FLIGHT, 4
HYPERSONIC INLETS, 19
HYPERSONIC SPEED, 4
HYPERSONIC VEHICLES, 25

I

ICE PREVENTION, 22
IDENTIFYING, 31
IMAGE PROCESSING, 6
IMAGING SPECTROMETERS, 55
IMAGING TECHNIQUES, 6
IMPACT LOADS, 27
IMPACT TESTS, 14
IN-FLIGHT SIMULATION, 44
INDUSTRIES, 10
INFORMATION MANAGEMENT, 13, 56
INLET FLOW, 25, 50
INSPECTION, 54
INSTRUMENT ERRORS, 51
INTAKE SYSTEMS, 19
INTERCONTINENTAL BALLISTIC MISSILES, 46
INTERNATIONAL COOPERATION, 9

J

JET MIXING FLOW, 38
JET PROPULSION, 31

K

K-EPSILON TURBULENCE MODEL, 35
KINEMATICS, 17

L

LARGE EDDY SIMULATION, 5
LAUNCH COSTS, 28
LAUNCH VEHICLE CONFIGURATIONS, 4
LAUNCH VEHICLES, 17, 28, 44, 46
LAUNCHING, 11, 44
LEADING EDGES, 31

LIFE (DURABILITY), 29, 31, 32
LIFE CYCLE COSTS, 28, 29
LIFTOFF (LAUNCHING), 3
LIGHTNING, 11
LIQUID FUELS, 38
LOGISTICS, 18, 23, 29
LOSSES, 39
LOUDSPEAKERS, 41
LOW FREQUENCIES, 41
LUBRICATION, 19

M

MACH CONES, 3
MACH NUMBER, 3, 20, 41
MAINTAINABILITY, 18
MAINTENANCE, 30, 31
MAINTENANCE TRAINING, 55
MAN MACHINE SYSTEMS, 46
MANAGEMENT INFORMATION SYSTEMS, 48
MANAGEMENT PLANNING, 32
MANAGEMENT SYSTEMS, 56
MANUALS, 41
MANUFACTURING, 42
MARKET RESEARCH, 7, 9, 10
MATHEMATICAL MODELS, 1, 10, 11, 20, 33, 34, 35, 44, 57
MEASURING INSTRUMENTS, 42, 53
MEDICAL SCIENCE, 39
METAL SHEETS, 21
MICROBALANCES, 53
MICROELECTRONICS, 45
MILITARY AIR FACILITIES, 42
MILITARY HELICOPTERS, 56
MILITARY TECHNOLOGY, 36
MINIATURIZATION, 39
MISSILES, 57
MODELS, 5, 10
MODULES, 57
MONITORS, 1, 18, 19
MONTE CARLO METHOD, 43
MULTIDISCIPLINARY DESIGN OPTIMIZATION, 25
MULTIVARIATE STATISTICAL ANALYSIS, 24

N

NACELLES, 50
NANOSATELLITES, 45
NAVIER-STOKES EQUATION, 3
NAVIGATION, 16
NAVIGATION AIDS, 15
NEURAL NETS, 23

NICKEL ALLOYS, 33
NITROGEN OXIDES, 38, 55
NOISE PREDICTION (AIRCRAFT), 58
NONDESTRUCTIVE TESTS, 31, 54, 55
NONLINEAR EQUATIONS, 57
NONLINEARITY, 5, 57
NOZZLE DESIGN, 20
NOZZLE FLOW, 21
NOZZLE GEOMETRY, 20, 21
NUMERICAL ANALYSIS, 11, 19, 24, 51

O

OBJECT-ORIENTED PROGRAMMING, 2
OBLIQUE SHOCK WAVES, 3
OILS, 19
OPERATING COSTS, 28
OPERATIONAL HAZARDS, 29
OPTIMIZATION, 26, 53
OSCILLATIONS, 41, 51
OXYGEN, 12
OZONE, 55

P

PARALLEL FLOW, 44
PERFORMANCE PREDICTION, 15
PERFORMANCE TESTS, 21, 34, 36, 43
PHYSICAL PROPERTIES, 27
PIEZOELECTRIC CERAMICS, 39
PILOT PERFORMANCE, 39
PILOT TRAINING, 40
PILOTLESS AIRCRAFT, 50
PLASTIC PROPERTIES, 35
POLICIES, 8, 9
POWDER METALLURGY, 30
PREDICTION ANALYSIS TECHNIQUES, 36, 38
PREDICTIONS, 32
PRESSURE DISTRIBUTION, 4
PRESSURE DRAG, 20
PRESSURE RATIO, 4, 20
PRESSURE SENSORS, 34
PREVENTION, 13
PROBABILITY THEORY, 23, 32
PROCEDURES, 5, 23, 25, 38
PRODUCT DEVELOPMENT, 39
PRODUCTION COSTS, 28
PROGRAM VERIFICATION (COMPUTERS), 34, 36
PROJECTILES, 3
PROPELLER EFFICIENCY, 20
PROPULSION, 14, 46, 47

PROPULSION SYSTEM CONFIGURATIONS, 48
PROPULSION SYSTEM PERFORMANCE, 48
PROVING, 20

Q

QUALITY CONTROL, 24

R

RADAR MEASUREMENT, 5
RADIATION MEASUREMENT, 26
RAIL TRANSPORTATION, 10
RAMJET ENGINES, 38, 46, 47, 48
RATES (PER TIME), 32
REAL TIME OPERATION, 54
RECEIVERS, 17
RECORDS MANAGEMENT, 48
RECTENNAS, 50
REFRIGERANTS, 50, 51
RELIABILITY, 32
RELIABILITY ANALYSIS, 24
REMOTE SENSING, 55
REPLACING, 42
REQUIREMENTS, 45
RESEARCH, 38, 39, 53
RESEARCH AND DEVELOPMENT, 46
REYNOLDS NUMBER, 41
RISK, 13
ROCKET ENGINES, 24, 47, 48
ROCKET VEHICLES, 17
ROLLER BEARINGS, 54
ROTARY WING AIRCRAFT, 56
ROTARY WINGS, 20
ROTOR AERODYNAMICS, 58
ROTORS, 37, 58
RUBBER, 49
RUNWAYS, 15

S

SABOT PROJECTILES, 3
SAFETY, 13, 18
SAFETY FACTORS, 11
SATELLITE DESIGN, 45
SATELLITE INSTRUMENTS, 55
SATELLITE OBSERVATION, 55
SCALE (RATIO), 42
SEALS (STOPPERS), 31
SENSITIVITY, 26
SEPARATED FLOW, 4, 19, 38, 44
SERVICE LIFE, 28, 29, 32

SHAFTS (MACHINE ELEMENTS), 35
SHEAROGRAPHY, 54
SHOCK WAVE INTERACTION, 36
SHOCK WAVES, 6
SHOPS, 31
SILICON, 49
SILICON CARBIDES, 49
SILICON DIOXIDE, 49
SILICON NITRIDES, 49
SIMULATION, 4, 27, 32, 44
SINGLE STAGE TO ORBIT VEHICLES, 4, 44, 48
SKIN (STRUCTURAL MEMBER), 21
SMALL SATELLITE TECHNOLOGY, 45
SMART MATERIALS, 39
SMART STRUCTURES, 39
SOFTWARE ENGINEERING, 17, 27
SOLVENTS, 49
SOUND GENERATORS, 41
SOUTH KOREA, 9
SPACE NAVIGATION, 17
SPACE SHUTTLE BOOSTERS, 46
SPACE SHUTTLE MAIN ENGINE, 48
SPACECRAFT CONFIGURATIONS, 4, 48
SPACECRAFT CONTROL, 16, 17, 57
SPACECRAFT GUIDANCE, 17
SPACECRAFT INSTRUMENTS, 45
SPACECRAFT LAUNCHING, 28
SPACECRAFT MODELS, 45
SPACECRAFT MOTION, 45
SPACECRAFT PERFORMANCE, 45
SPACECRAFT STABILITY, 45
SPACECRAFT TRACKING, 17
SPECIFICATIONS, 42
SPECTRORADIOMETERS, 55
SPEED INDICATORS, 23
SPRAY CHARACTERISTICS, 38
STABILIZERS (FLUID DYNAMICS), 38, 52
STARDUST MISSION, 43
STRAIN GAGE BALANCES, 51, 52, 53
STRAIN GAGES, 53
STRATOSPHERE, 55
STRESS CORROSION, 21
STRESS-STRAIN RELATIONSHIPS, 53
STRUCTURAL ANALYSIS, 14, 22, 23, 26, 32
STRUCTURAL DESIGN, 27
STRUCTURAL DESIGN CRITERIA, 22
STRUCTURAL ENGINEERING, 26
STRUCTURAL FAILURE, 31, 37
SUBSONIC FLOW, 35
SUBSONIC SPEED, 21

SUBSONIC WIND TUNNELS, 5
SUPERHIGH FREQUENCIES, 42
SUPERSONIC AIRCRAFT, 6, 40
SUPERSONIC COMBUSTION RAMJET ENGINES, 47
SUPERSONIC DRAG, 44
SUPERSONIC FLOW, 41
SUPERSONIC TRANSPORTS, 26
SUPERSONIC WIND TUNNELS, 41
SUPPORT SYSTEMS, 18
SURFACE CRACKS, 31
SURFACE TEMPERATURE, 12
SURVEYS, 22, 46
SWATH WIDTH, 55
SYSTEM FAILURES, 48
SYSTEMS ANALYSIS, 18
SYSTEMS ENGINEERING, 27, 51

T

TECHNOLOGY ASSESSMENT, 29, 32
TECHNOLOGY UTILIZATION, 45
TELEMETRY, 45, 57
TELEVISION CAMERAS, 43
TENSILE STRENGTH, 2
TEST CHAMBERS, 41
TETHERING, 47
THERMAL ANALYSIS, 12, 44
THERMAL PROTECTION, 12, 44
THREE DIMENSIONAL FLOW, 20, 33, 34
THREE DIMENSIONAL MODELS, 19
THRUST CONTROL, 14
THRUST MEASUREMENT, 21
THRUST VECTOR CONTROL, 21, 26
TIME OPTIMAL CONTROL, 17
TOLERANCES (MECHANICS), 32
TORQUE, 35
TOUCHDOWN, 43
TOURISM, 11
TRAINING DEVICES, 40
TRAINING SIMULATORS, 43
TRAJECTORY ANALYSIS, 3, 37
TRANSONIC COMPRESSORS, 37
TRANSONIC SPEED, 20
TRANSONIC WIND TUNNELS, 52
TRANSPORT AIRCRAFT, 13, 14, 19, 55
TURBINE BLADES, 29, 30
TURBINE ENGINES, 32, 37, 49, 54
TURBINE PUMPS, 48
TURBINES, 30, 33, 36
TURBOCOMPRESSORS, 33, 34
TURBOJET ENGINES, 31, 36
TURBOMACHINERY, 1, 20, 31

TURBOPROP ENGINES, 31
TURBOSHAFTS, 31
TURBULENCE MODELS, 5
TURBULENT FLOW, 5

U

ULTRAHIGH FREQUENCIES, 42
UNSTEADY FLOW, 36, 41
UNSTRUCTURED GRIDS (MATHEMATICS), 4
URBAN TRANSPORTATION, 10

V

V-22 AIRCRAFT, 20, 58
VACUUM DEPOSITION, 30
VALIDITY, 50
VAPOR DEPOSITION, 30
VELOCITY DISTRIBUTION, 35
VENTILATION, 50
VERTICAL MOTION, 2
VIBRATION, 48
VIBRATION DAMPING, 41
VIBRATION MODE, 24
VIDEO TAPES, 13
VISUAL STIMULI, 2
VOLATILITY, 49
VORTEX BREAKDOWN, 5
VORTICES, 5

W

WAKEFULNESS, 56
WARNING SYSTEMS, 15
WEAR, 31
WELDING, 30
WIND TUNNEL APPARATUS, 51, 52
WIND TUNNEL TESTS, 5, 20, 38, 52
WIND TUNNELS, 51, 53
WINDOWS (COMPUTER PROGRAMS), 27
WINGS, 22
WORKING FLUIDS, 27

X

X-33 REUSABLE LAUNCH VEHICLE,
3, 4, 40, 44, 45

Y

YAW, 2

Personal Author Index

A

Agrawal, G. L., 53
Alexander, Reginald Andrew, 44
Alonso, Juan J., 25
Alter, Stephen J., 3
Anderson, D. E., 55
Artmeier, M., 35
Asbury, Charles N., 56

B

Bacon, Barton J., 26
Banos–Pino, Jose, 10
Barnes, T., 12
Barnes, Terence, 42
Barnette, Bill, 14
Barron, Michael L., 37
Betancor, Ofelia, 7
Binks, D., 50
Bluemel, Peter, 32
Blum, C., 45
Booth, Earl R., Jr., 20
Bossi, Richard, 54
Botes, C. J., 18
Botha, Gavin, 20
Bowen, Brent D., 6
Bowers, Albion H., 6
Boyd–Lee, A. D., 31
Branco, C. Moura, 33
Briand, Sophie, 7
Broede, Juergen, 32
Brooks, Thomas F., 58
Brown, C., 47
Brucker, G. J., 26
Bull, Barton, 17
Burke, Jack M., 48
Burken, John J., 39
Burkes, Darryl A., 44
Burley, Casey L., 58
Burlon, Daniel, 31
Burner, Alpheus W., 53
Byrne, J., 33

C

Caidwell, J. L., 56
Caidwell, John A., Jr., 56
Cale, Mary L., 16
Calvert, W. John, 33
Campos, Javier, 7
Cardosi, K., 15
Casciaro, C., 35
Chamis, Christos C., 32
Charles, Bruce D., 58
Cheatwood, F. McNeil, 43
Chen, Ping–Hei, 58
Chima, R. V., 37
Cleary, T., 14

Colantonio, R. O., 38
Coney, M. H., 50
Cornish, J., 12
Cornish, Jeremy, 22
Cotting, M. Christopher, 39
Craig, James I., 25
Culver, Harry, 45

D

Dachev, T. P., 26
Dawson, Seth, 20
DeCoursey, R. J., 5
Deere, Karen A., 20
DeFiore, T., 12
DeFiore, Thomas, 42
Dennis, Nigel P. S., 10
Deobald, Lyle, 54
Desai, Prasun N., 43
Diaz, R., 12
Dimitrov, P. G., 26
Domas, P. A., 31
Doria, Richard, 49
Duangphastra, Chakrit, 9

E

Emanuel, M., 47
Estes, Robert D., 47
Ewing, M., 38
Eyre, F., 12
Eyre, Frank, 22

F

Farokhi, S., 38
Fasanella, Edwin L., 26
Feraud, Pierre, 18
Finley, Tom D., 53
Folta, David, 17
Forsyth, Graham F., 1
Fox, Dennis S., 48
Francis, Ronnie, 45
Franeknberger, C. E., 37
Frith, Peter, 33
Fujino, Yoshiyuki, 42, 49
Fujita, Masaharu, 42, 49
Fukui, Toshio, 4
Fulton, Robert E., 25

G

Gilchrist, Brian, 47
Gill, John, 17
Ginder, R. B., 34
Giunta, Anthony A., 26
Goldfeld, M. A., 19

Goldman, A., 47
Graves, Sharon S., 5
Greenhalgh, Samuel, 22
Gregory, Irene M., 40
Grosshandler, W., 14
Gwilliam, N. J., 36
Gyarmathy, G., 35
Gyoda, Koichi, 42

H

Haas, David J., 22
Haering, Edward A., Jr., 6
Hait, Mitchell J., 48
Hall, Charles, 44
Hall, Kecia K., 56
Hanagud, S., 39
Hannick, Sidney L., 22
Hannon, D., 15
Hansen, G. M., 5
Harigae, M., 16
Harima, Katsushige, 41
Harrison, G. F., 31
Hastings, R. R., 28
Healy, Thomas J., Jr., 46
Heavey, Karen R., 3
Heisler, A., 35
Heitmeir, F. J., 35
Hendrix, N. Douglas, 44
Henry, Michael W., 41
Higashino, Shin–ichiro, 2
Hodges, Dewey H., 57
Hodges, J., 19
Hoenen, H., 31
Hollis, Brian R., 3, 4
Holzbecher, W., 28
Hooper, Paul, 9
Horn, M., 47
Horrocks, D. M., 50
Horsley, Dave, 18
Hostetler, C. A., 5
Hufnagel, K., 52
Hyde, T. H., 35

I

Ikematsu, Takashi, 2
Inagaki, T., 16
Inglada, Vicente, 10
Ishida, K., 44
Ivey, P. C., 33

J

Jackson, Karen E., 26
Jackson, Mark, 44
Jacobson, Nathan S., 48
Johnson, Les, 47

Jones, Patti, 45
Junkin, Brent, 29

K

Kawa, S. R., 55
Kaya, Nobuyuki, 49
Kelvin, Alex, 7
Kent, G. S., 5
Ketchum, A., 47
Kim, Jongseok, 9
Kim, Ki C., 24
Kim, Steven S., 24
King, Michael D., 55
Kingston, T. R., 36
Kirschmann, Arthur, 53
Knutson, Benjamin, 54
Kobayashi, T., 21
Koons, H. C., 11
Kothari, A. P., 24
Koyama, Shigeru, 50
Kramer, Lynda J., 11
Krider, E. P., 11
Krupp, Don, 44
Kubota, Hirotsoshi, 4
Kumakawa, A., 38
Kuwahara, Ken, 50

L

Lai, Chun-Liang, 2
Lee, Da-Sheng, 58
Lenoir, Nathalie, 10
Leone, John F. X., 41
Lewellen, D. C., 5
Lewellen, W. S., 5
Li, G., 50
Liburdi, J., 30
Lin, Huang, 2
Lindell, Michael C., 52
Long, M. W., 21, 23
Lorenzini, Enrico, 47
Lubrano, Phillippe, 18
Lyes, P. A., 34

M

Macy, T., 13
Macy, Tim, 13
Marker, T. R., 12
Martell, Hugh, 17
Martin, Colin, 23
Martin, Juan Carlos, 6, 8
Martinez-Sanchez, Manuel, 47
Maruo, Hiroko, 40
Mason, Keith J., 10
Masuzawa, Hiroshi, 41
Matsumoto, Shinichi, 4
Matsumoto, Tatsuya, 50
McCluer, Megan, 58
McCool, Kelly M., 22
McDonald, A. Blair, 14
McGuire, R., 13

McGuire, Robert, 13
McGuirk, J. J., 50
Meinders, B., 45
Miao, Jr-Ming, 58
Micklos, R., 12
Micklos, Richard, 42
Mineck, Raymond E., 4
Mirsafian, S., 38
Mistree, Farrokh, 25
Mitcheltree, Robert A., 43
Morelli, Eugene A., 5
Morikawa, Takao, 41
Moss, J. B., 50
Muldoon, Rick, 17
Mullender, A. J., 50
Murata, M., 16
Murphy, Kelly J., 3, 4

N

Nagai, Kenichiro, 41
Namba, Masanobu, 40, 41
Nangia, R. K., 19
Narciso, J. D., 21, 23
Nelson, James, 54
Nerenberg, Robert, 54
Nestoulia, R. V., 19
Nicholas, T., 29
Niedzielski, Paul, 14
Nishiyama, Hiroyasu, 50
Noda, J., 44
Nombela, Gustavo, 6, 8
Nomizo, K., 44
Norman, David N., 56
Nowak, Robert J., 3, 4
Nowell, D., 34

O

Oaks, Robert D., 16
Ohara, Junichi, 50
Onda, Masahiko, 49
Ono, T., 16
Opila, Elizabeth J., 48
Oreper, Gregory, 19
Orme, John S., 21
Ortwerth, P., 47
Ostrander, Mark J., 57
Ostroff, Aaron J., 26
Otsuka, Takeshi, 40
Oum, Tae Hoon, 6, 9

P

Pablo, Coto-Millan, 10
Padmos, P., 43
Paglione, Mike M., 16
Palmer, M. E., 19
Panten, M., 31
Parker, Peter A., 51
Parmington, Ben, 18
Parvez, Shabbir A., 17
Paschkewitz, John S., 27

Patel, Naresh R., 52
Patnaik, P. C., 30
Pearl, Ira G., 48
Polites, Michael E., 16
Poole, L. R., 5
Prabhu, Ramadas K., 3, 4
Press, Jacques, 11
Profillidis, V., 11

R

Radons, U., 35
Ratekin, G., 47
Rebbechi, Brian, 18
Rhew, Ray D., 52
Riley, Christopher J., 3
Robinson, Raymond C., 48
Robotham, W. S., 35
Rogacki, J. R., 46
Rogers, Mark N., 57
Rogers, Stepven P., 56
Romero, Manuel, 6, 8
Rubini, P. A., 50
Rust, W. D., 11
Ryan, Hollis F., 16

S

Sahu, Jubaraj, 3
Sakamoto, H., 38
Sakurai, Akira, 2
Sanmartin, Juan, 47
Sasaki, M., 38
Schaefer, Carl G., Jr., 22
Schaeffer, Harry G., 27
Schmidt, C. G., 21
Schrage, Daniel P., 25
Schroeder, Jeffery Allyn, 2
Seablom, Kirk D., 41
Sekine, H., 44
Sell, M., 35
Seto, Masayuki, 2
Sherwood, T., 38
Shinozuka, Takashi, 42
Shockey, D. A., 21
Shtessel, Yuri, 44
Sims, Robert L., 21
Singer, Chirs, 48
Sinowitz, Allen, 49
Smeets, J., 30
Smialek, James L., 48
Smith, G. C., 36
Smout, P. D., 33
Smythe, Nicholas K., III, 56
Sobieszczanski-Sobieski, J., 26
Soeder, Ronald H., 41
SousaeBrito, A., 33
Stacy, Kathryn, 6
Stanley, Thomas Troy, 44
Stapleton, A. W., 36
Stark, David E., 41
Stassinopoulos, E. G., 26
Stauffer, C. A., 26
Stewart, C. D., 50

Suenaga, Hisashi, 4
Sugiura, Akira, 41
Summerill, J. S., 16

T

Takahashi, M., 38
Takashima, N., 24
Tani, T., 44
Taylor, J. W., 35
Taylor, Jonathan B., 15
Tcheng, Ping, 51, 53
Thamburaj, R., 30
Thomas, Wayne, 29
Thompson, Richard A., 3, 4
Tomita, Kazumasa, 49
Tomov, B. T., 26
Toshimitsu, Kazu, 40, 41
Trefny, C. J., 47
Tripp, John S, 51
Tripp, John S., 53
Tschirne, K. U., 28
Tsujii, T., 16

V

Vieira, Gerald J., 6
Vondrell, Jack U., 46

W

Wallace, Kevin Shawn, 27
Walterscheid, R. L., 11
Watanuki, Tadaharu, 4
Weinstein, Leonard M., 6
Weir, John, 49
Wells, Eugene M., 45
Wheeler, Craig M., 14
Willett, J. C., 11
Williams, D. P., 34
Williams, E. J., 35
Williams, T. J., 29
Wong, Albert, 18
Wood, Richard M., 39
Wood, Terrence L., 39
Wood, William A., 3

X

Xing, Guang Q., 17

Y

Yamagata, Akihiro, 41
Yamauchi, Gloria K., 20
Yatsuyanagi, N., 38
Yianguang, Yang, 53
Yoon, Suk-Hong, 10
Young, Larry A., 20
Yu, Jian, 50
Yungster, S., 47

Z

Zhai, Junnai, 52
Zhang, A., 1, 24
Zhigong, Tang, 53

Report Documentation Page

1. Report No. NASA/SP—1999-7037/SUPPL408	2. Government Accession No.	3. Recipient's Catalog No.	
4. Title and Subtitle Aeronautical Engineering A Continuing Bibliography (Supplement 408)		5. Report Date October 1999	
		6. Performing Organization Code	
7. Author(s)		8. Performing Organization Report No.	
9. Performing Organization Name and Address NASA Scientific and Technical Information Program Office		10. Work Unit No.	
		11. Contract or Grant No.	
12. Sponsoring Agency Name and Address National Aeronautics and Space Administration Langley Research Center Hampton, VA 23681		13. Type of Report and Period Covered Special Publication	
		14. Sponsoring Agency Code	
15. Supplementary Notes			
16. Abstract This report lists reports, articles and other documents recently announced in the NASA STI Database.			
17. Key Words (Suggested by Author(s)) Aeronautical Engineering Aeronautics Bibliographies		18. Distribution Statement Unclassified – Unlimited Subject Category – 01	
19. Security Classif. (of this report) Unclassified	20. Security Classif. (of this page) Unclassified	21. No. of Pages 86	22. Price A05/HC

